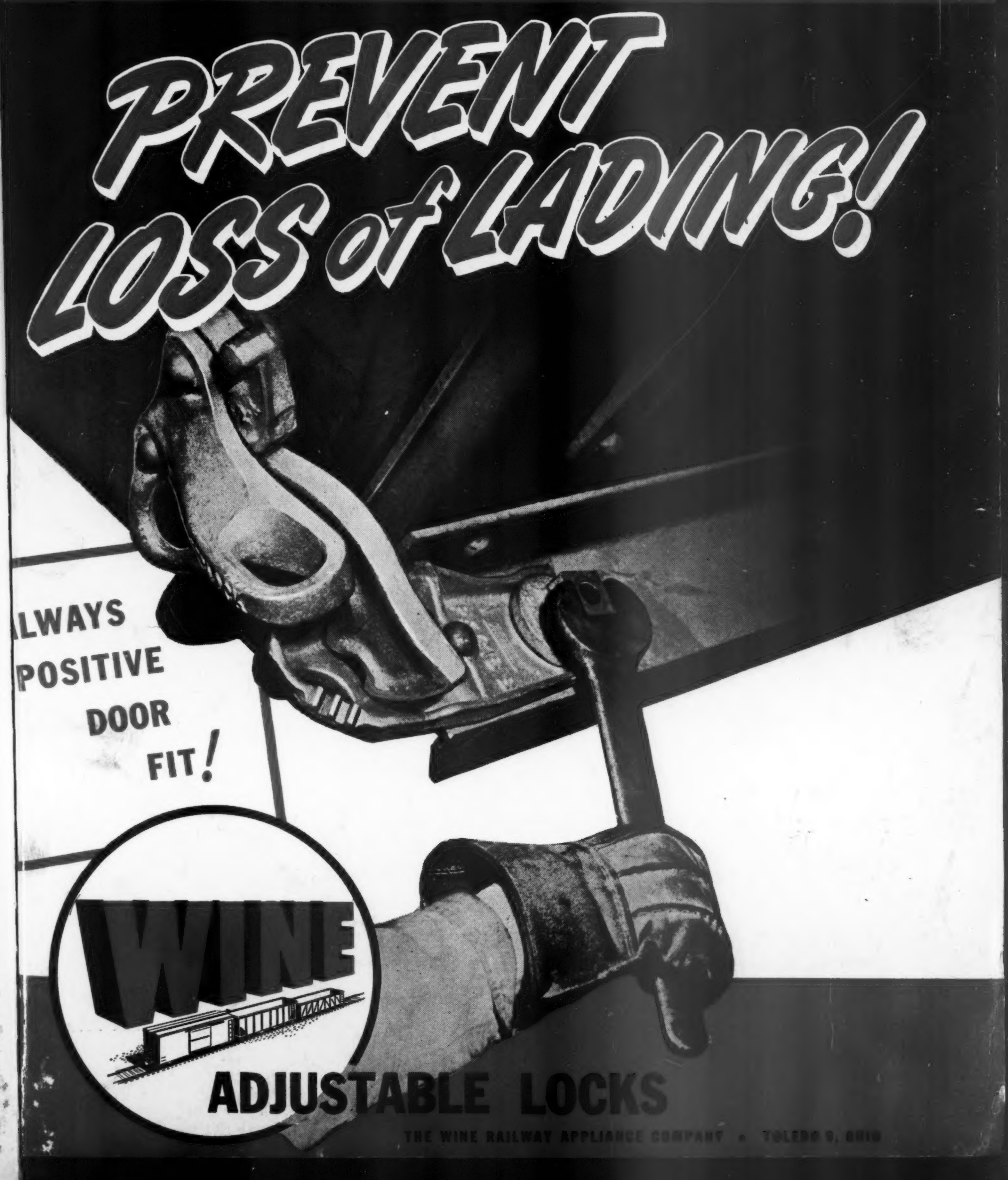
JANUARY, 1950

RAILWAY Mechanical and Electrical Engineer



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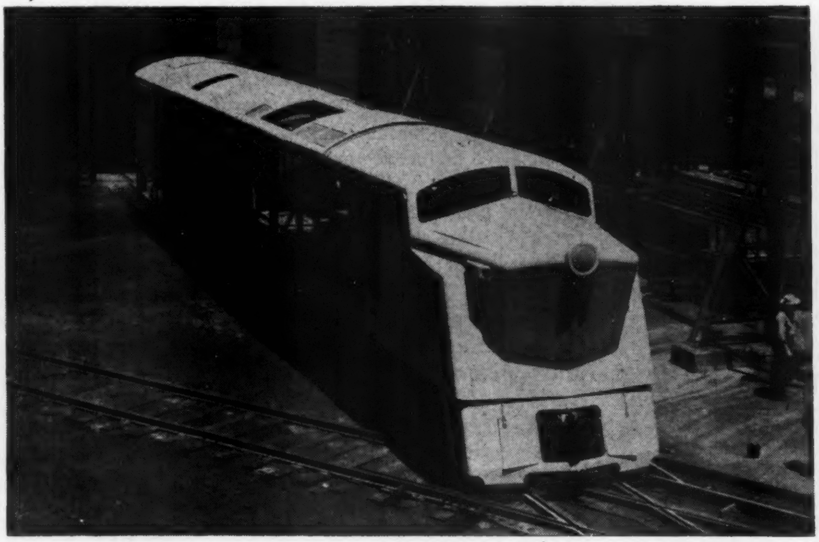
4,000-Hp. Gas Turbines Passenger Locomotives*

Experimental unit now being built by Westinghouse will use heavy oil fuel and have total weight of 460,000 lb.



W. A. Brecht,

Charles Kerr, Jr.

and

T. J. Putz†

THE Westinghouse Electric Corporation is constructing an experimental 4,000 hp. gas turbine locomotive for passenger service. The locomotive is being built in one unit, arranged for single-end operation, and will be carried on four two-axle swivel trucks. All eight axles will be equipped with traction motors, making 100 per cent of the total weight available for adhesion.

The main power supply will be secured from two 2,000 hp. simple, open-cycle gas turbine generator sets, located side by side in the locomotive cab with a center aisle. Steam for train heating will be provided by two boilers, having a total steam producing capacity of 5,000 lb. per hour.

The major dimensions, weights, and ratings of the locomotive are presented in the accompanying table. As a ready guide by which to evaluate the dimensions of this locomotive similar figures are given for a conventional Diesel passenger locomotive of comparable capacity. In general terms, the gas turbine locomotive will have approximately two-thirds of the weight and one-half of the length of the Diesel.

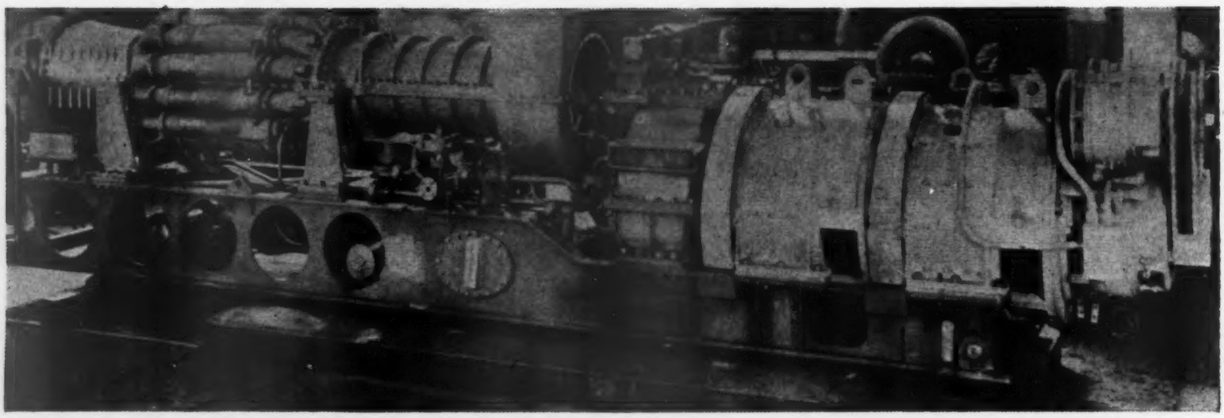
As an electric transmission is used, the output of this locomotive will be identical to that of a Diesel-electric of similar horsepower capacity. Consequently, the gas turbine and the Diesel of equal plant capacity and equal number of driving motors are strictly on a par except the gas turbine can haul one more car because of lower locomotive weight. Any major advantage achieved by either will stem from the operating economies of the prime mover, and the improved locomotive design which either type of power plant may make possible.

Mechanical Construction

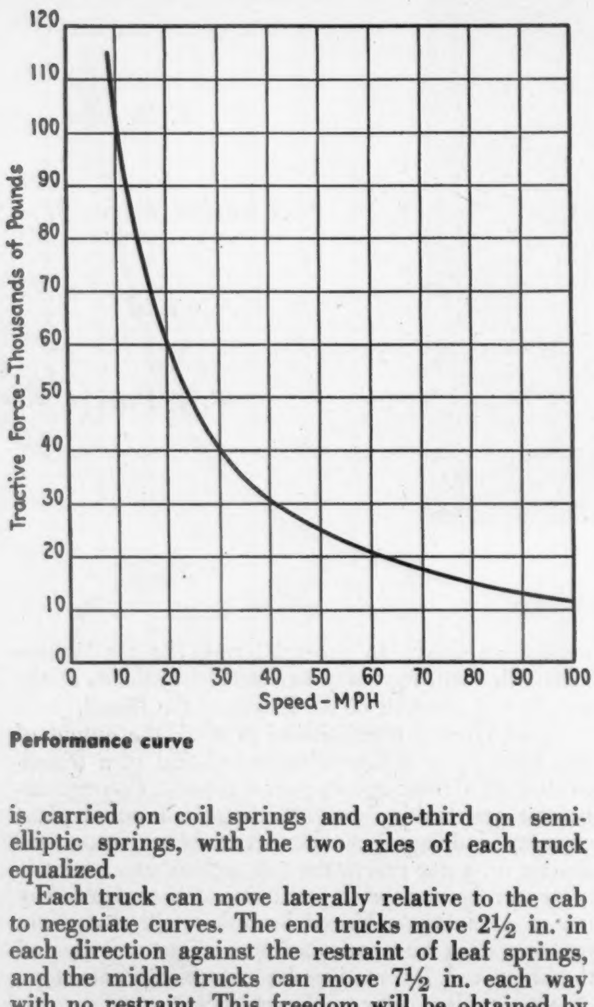
The locomotive cab will be carried directly on four identical two-axle trucks. These trucks are conventional in design, except for their lateral-motion devices. The trucks have cast frames and clasp-type brake rigging. By the use of soft springs the cab load is, for all practical purposes, equally distributed among the four trucks, even with normal track irregularities. Approximately two-thirds of the load

* Abstract of paper presented at the annual meeting of the American Society of Mechanical Engineers, Gas Turbine Power Division, at the Hotel Statler, New York, November 29, 1949.

† The authors are all with Westinghouse Electric Corporation and are, respectively, manager transportation engineering department, consulting transportation engineer, and manager, locomotive and gas turbine engineering division.



2,000-hp. gas-turbine power plant



Performance curve

is carried on coil springs and one-third on semi-elliptic springs, with the two axles of each truck equalized.

Each truck can move laterally relative to the cab to negotiate curves. The end trucks move 2½ in. in each direction against the restraint of leaf springs, and the middle trucks can move 7½ in. each way with no restraint. This freedom will be obtained by interposing a roller carriage between each truck and the cab underframe. The cab rests on rollers in the carriage which is supported on the truck frame by a center-pin. Thus lateral motion is taken between the cab and the carriage, and swiveling action takes place between the carriage and the truck frame. This arrangement provides a no-lift feature which is essential for equalization of load between trucks. The lateral restraint springs are of the multi-leaf type and wrap around a curved surface as they deflect. This wrapping action limits the stress to a predetermined value and gives a rising characteristic, which is desirable for the cushioning of lateral blows.

The rollers which carry the weight of the cab are themselves carried on roller bearings which are grease-packed for life. These rollers are arranged to give the equivalent of a three-point support over each truck so that slight irregularities in the contact surface will not cause a major shift in loading on the rollers.

This unconventional arrangement of running-gear has advantages from the standpoint of tracking, simplicity, ease of maintenance, and light weight. The tracking stability of a truck type locomotive at high speed is dependent largely on the center-pin spacing. In the case of this locomotive, the trucks with lateral restraint are at the ends, so that the effective center-pin spacing is large. If the more conventional span bolster arrangement were used to connect the trucks together in pairs, the center-pin spacing would be much smaller.

This truck arrangement simplifies the often difficult problem of traction motor ventilation. Air from the main cab ducts flows through large circular openings in the carriages and then through the truck center pins to the motors. A simple spring-loaded air seal is required between the carriages and the cab underframe.

The cab is a completely welded structure, with all weight carrying and buffing strength provided in the underframe which consists of four I beams, with welded cross ties as required. This underframe carries about half of the fuel oil supply, provides main ventilating ducts for the traction motors and a housing for the locomotive battery. The superstructure of the locomotive is a lightly trussed shell to house the equipment, with removable metal-clad plywood side panels and roof hatches for maintenance purposes.

Gas Turbines

The locomotive will be powered by two 2,000 hp. gas turbine generator units, each consisting of a compressor, turbine, gear reduction unit, and generator all mounted on a common bedplate which serves as a lubricating oil storage and houses the motor-driven auxiliaries and fuel oil control valves. The units will

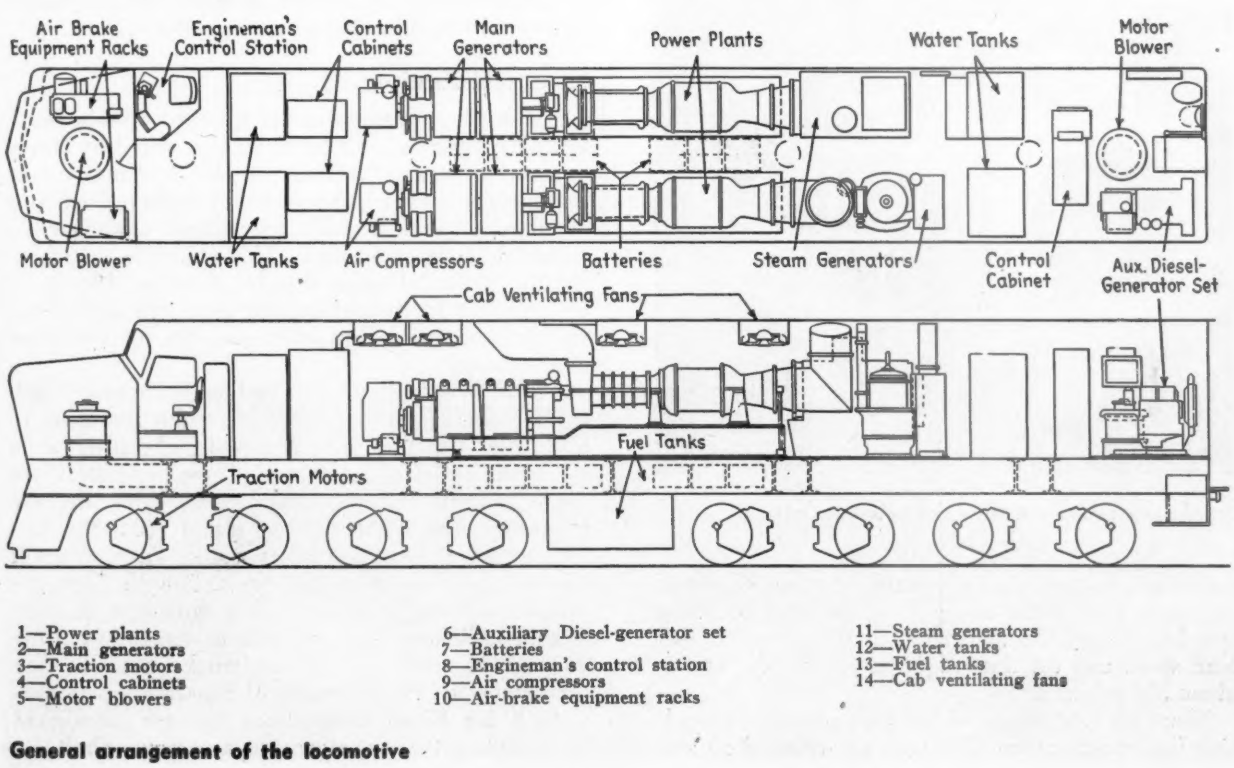
be mounted in the locomotive on a three-point suspension which prevents the weaving of the main locomotive frame from being transmitted to the turbine equipment with possibilities of disalignment. The units will be rated 2,000 hp. net for traction with ambient conditions of 80 deg. F. and sea level pressure.

The development of these gas turbine units for locomotive service started in 1945. In September 1946 an experimental 2,000 hp. turbine generator unit was started on the manufacturer's test floor and operated until December, 1948. During this period this experimental unit was operated a total of 1,500 hours with several thousand load cycles simulating locomotive operation. This experimental unit was then modified for a field application to pump natural gas on the line of the Mississippi River Fuel Corporation at Wilmar, Arkansas. The direct current generators and reduction gear were replaced with a direct connected high speed centrifugal gas booster. This field application was made to accelerate life tests on the high temperature parts of the gas turbine unit. The two units for this locomotive are essentially duplicates of this experimental test model.

Air for the gas turbine will enter through the cab roof and be carried by ducts to the compressor inlets. These ducts will be insulated on the outside for noise suppression. Tests on various locomotives have shown that the cab roof location gives the cleanest possible air. Screens will be provided in the inlet ducts and road tests will show whether more elaborate air cleaning and filtering will be necessary in locomotive operation. The air then flows through the 23-stage axial flow compressor where the pressure will be increased approximately five fold. It then passes into 12 combustors where fuel is mixed and burned raising the temperature to 1350 deg. F. before entering the 8-stage gas turbine. Approximately two-thirds of the power developed by the turbine is absorbed in driving the compressor, the remainder being available for useful work. The combustors are fitted with air atomizing type nozzles to burn various liquid fuels from the light Diesel oils to heavier Bunker C oils efficiently over a wide load range. When the heavier oils are used, the units will be started and shut down using light fuel which is provided for the train heating boilers. Steam coils in the main fuel tanks will maintain the heavier oil at 100 deg. F. for handling. This oil is further heated by passing it through a steam heater to raise the temperature to 240 deg. F. prior to entering the nozzles in the combustors. All grades of Bunker C oil cannot be used indiscriminately in a given combustor design. The Bunker C oils used will be tested for compatibility with one another and for their ash deposit characteristics. It is hoped that this experimental locomotive will help determine and establish the necessary fuel specifications for a suitable heavy gas turbine fuel. The gas turbines will be started

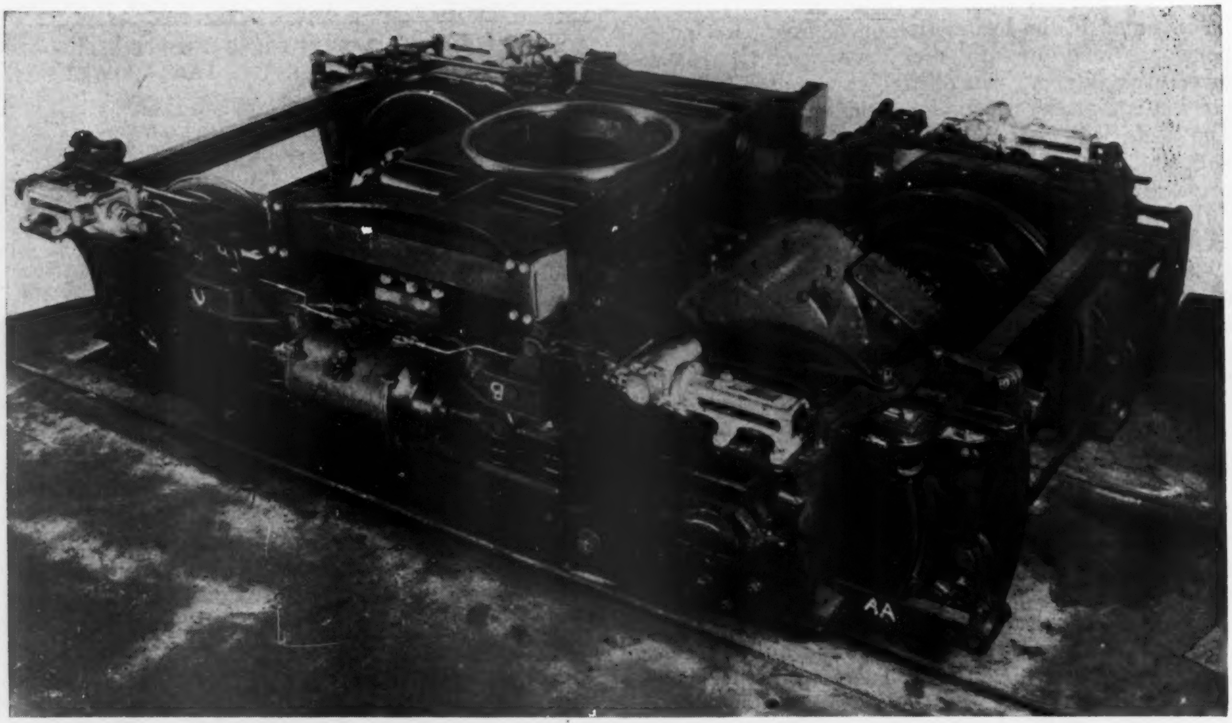
COMPARISON OF GAS TURBINE AND DIESEL-ELECTRIC LOCOMOTIVE OF THE SAME POWER

	Westinghouse Gas Turbine	Typical Diesel
Wheel arrangement	B-B-B-B	2 (A1A-A1A)
Length overall, ft.-in.	77 – 10	142 – 0
Width, ft.-in.	10 – 0-¾	10 – 7
Height, ft.-in.	14 – 1	14 – 1
Rigid wheel base, ft.-in.	9 – 0	14 – 1
Total wheel base, ft.-in.	62 – 9	127 – 0
Wheel diameter, ft.-in.	0 – 42	0 –42
Total locomotive weight, lb.	460,000	650,000
Weight on drivers, lb.	460,000	450,000
Per driving axle, lb.	57,500	56,250
Rated hp.	4,000	4,000
Starting tractive force—25 per cent adhesion	115,000	112,500
Continuous tractive force	52,800	52,800
Maximum speed m.p.h.	100	100

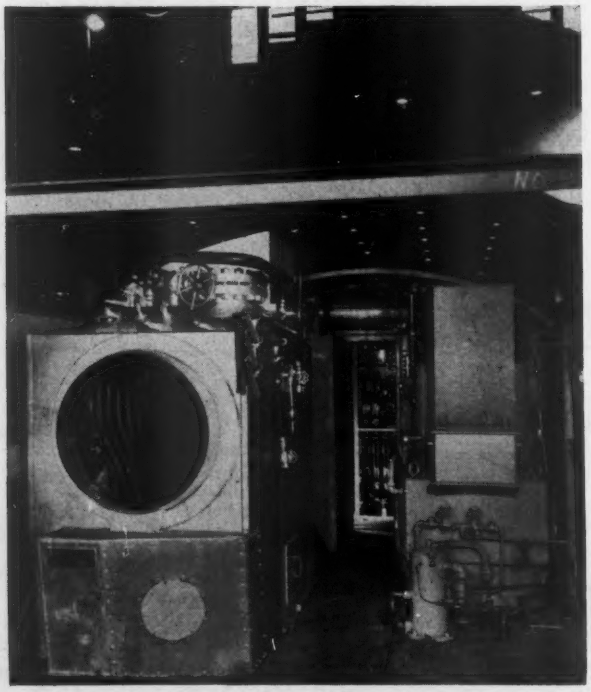


1—Power plants
2—Main generators
3—Traction motors
4—Control cabinets
5—Motor blowers
6—Auxiliary Diesel-generator set
7—Batteries
8—Engineman's control station
9—Air compressors
10—Air-brake equipment racks
11—Steam generators
12—Water tanks
13—Fuel tanks
14—Cab ventilating fans

General arrangement of the locomotive



Locomotive truck with carriage



Steam generators—Waste-heat boiler on left

by using a battery to supply cranking power to one of the main generators acting as a motor. The idling speed of the units is approximately 60 per cent of full load speed and the time required to start the unit is about 3½ minutes.

There are two groups of fuel tanks, one for propulsion fuel which can be filled with any selected oil and one exclusively for Diesel fuel primarily for the train heating boilers. The tanks assigned to propulsion fuel are located in the underframe between No. 2 and 3 trucks. These carry a total of 36,000 lb. They will be supplied with steam heating coils to permit handling fuel oils. The tanks assigned exclusively to Diesel fuel are located under the cab floor.

Approximately 20,000 lbs. of water will be carried by tanks located in the locomotive cab.

Electrical Equipment

An electric transmission for a gas turbine is essentially the same as for a locomotive powered by Diesel engines or steam turbines. In this locomotive, the main propulsion apparatus will be taken from our standard Diesel line with only slight modifications to certain component parts. This ability to standardize the electrical apparatus is of major benefit to the builders for manufacturing purposes and to the railroads because of interchangeability for improved maintenance.

On the Westinghouse gas turbine locomotive, each turbine drives through a single reduction gear to a double armature d.c. generator operating at a maximum speed of 1,150 rpm. These generators are self-ventilated, and to assure clean, cool air, the generator compartment is separated from the turbine by a bulkhead and all incoming air is filtered. Air is exhausted from the generators through the cab floor. These generators are arranged electrically so that each armature supplies power to two traction motors mounted in one truck. Actually, the generators are an adaptation of generators previously built for Diesel applications but are redesigned for mounting two armatures on a common shaft.

A 50 k.w. auxiliary generator is carried on an extension of each main generator shaft for battery charging and to supply power for control and auxiliaries. The generator exciter and pilot exciter are belted from each generator shaft. Because the speed torque curve of the gas turbine is considerably different from that of a Diesel engine, a pilot exciter will be included to make the electric drive loading more closely follow the prime mover output. An air brake compressor is driven directly from each main power plant.

The traction motors are standard Type 370 Westinghouse motors such as used on road Diesels. These motors will be geared 22:57 to permit maximum speeds of 100 m.p.h. With a total of eight motors, the prime mover capacity per motor corresponds to Diesel passenger practice.

Two traction motor blowers are included, one located in the front hood and the second blower at the rear of the locomotive. These electrically-driven blowers are equipped with dirt cleaning features. They are vertical blowers of the propeller type, handling 12,000 c.f.m. per unit. Special provisions will be made to secure clean air and to prevent recirculation of hot air.

An auxiliary 75 hp. Diesel engine generator set will be included for emergency battery charging and to move the light locomotive around shops without operating the gas turbine. This set will not be required for normal operation of the locomotive, and experience may prove that it is unnecessary.

Control Equipment

The requirements of a control for a gas turbine electric locomotive parallel, to a great extent, those for a Diesel electric. The electric drive is a torque converter which delivers constant horsepower at the locomotive drivers over a wide speed range. The purpose of all control schemes, when applied to electric drives, is to regulate the fuel supply of the prime mover to suit the load demand and to proportion the electrical loading on the prime mover in accordance with its output. The major difference between Diesel and gas turbine control lies in those features which come about by the characteristics of the two prime movers, and largely deal with fuel supply. In this locomotive, the basic control medium is the turbine governor, which in connection with the engineman's controller, determines the output of the locomotive.

Train Heating Equipment

The locomotive will carry two train heating boilers, each rated at 2,500 lb. of steam per hour. One boiler is a standard unit similar to those used on Diesels.

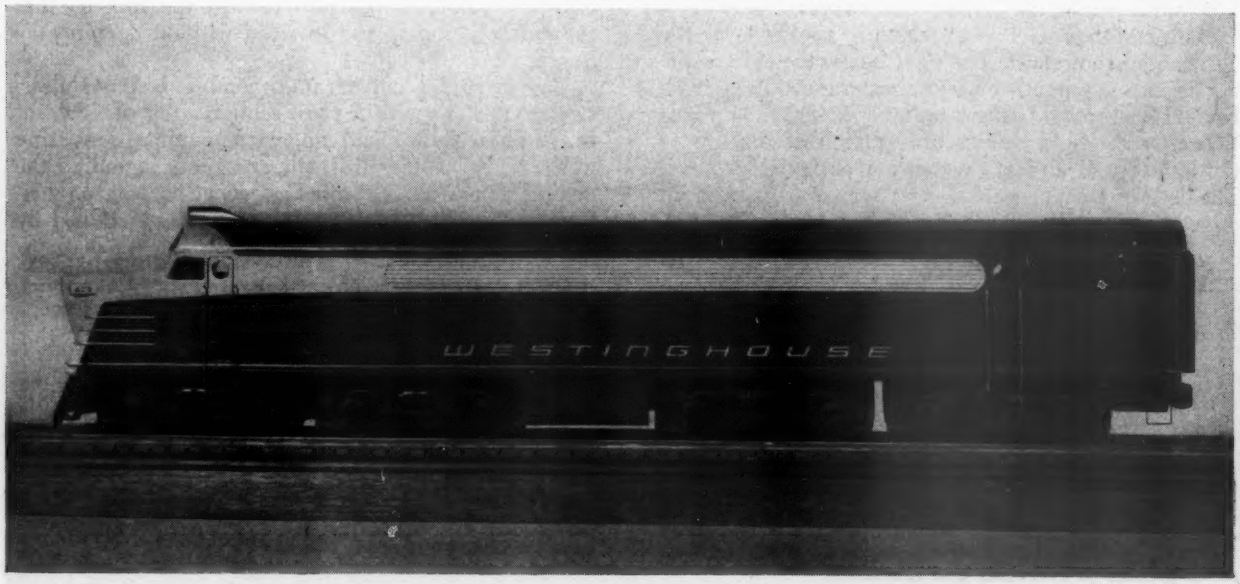
The second unit is a waste heat boiler built by Babcock and Wilcox for this locomotive. When the turbine is operating, the exhaust from the turbine will furnish heat for the production of steam. To maintain full boiler capacity at light loads or at shutdowns, an auxiliary burner will be used. The use of waste heat should produce a major reduction in fuel requirements for train heating purposes.

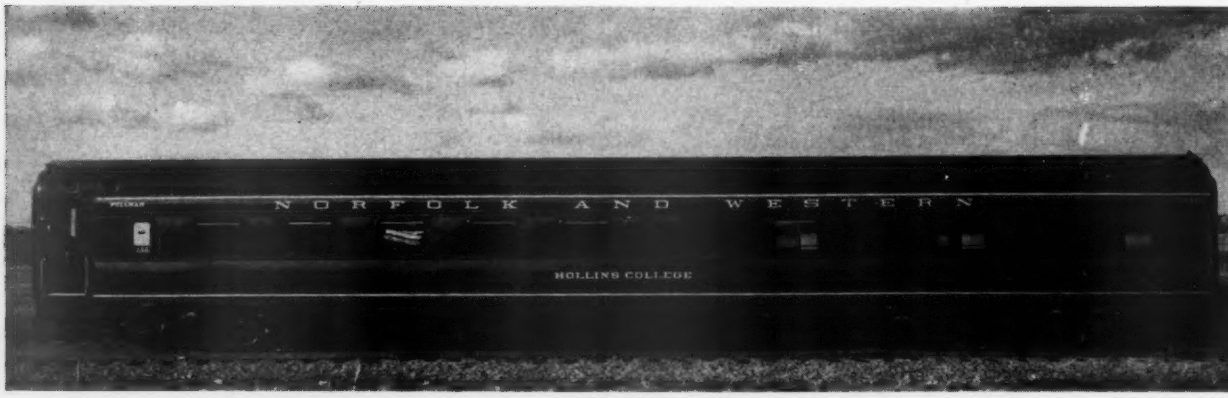
Future Considerations

Looking to the future, the gas turbine offers many attractions. As a power plant, large capacity can be placed in a limited space compared with other types of prime movers. Since space at a premium in locomotive design, the gas turbine will open new fields.

Steam turbines have been developed to the point where they operate for exceptionally long periods without maintenance. The gas turbine should eventually approach this performance of its steam counterpart. Approximately half of the total locomotive maintenance expense is chargeable to the engine on the modern Diesel, and the gas turbine should reduce this expense.

The gas turbine, as we see it today, will be generally limited to locomotives of large capacity. Just where this dividing line exists, we do not yet know, but suspect it is probably 2000-3000 HP and above. In the smaller sizes, its first cost does not appear competitive.





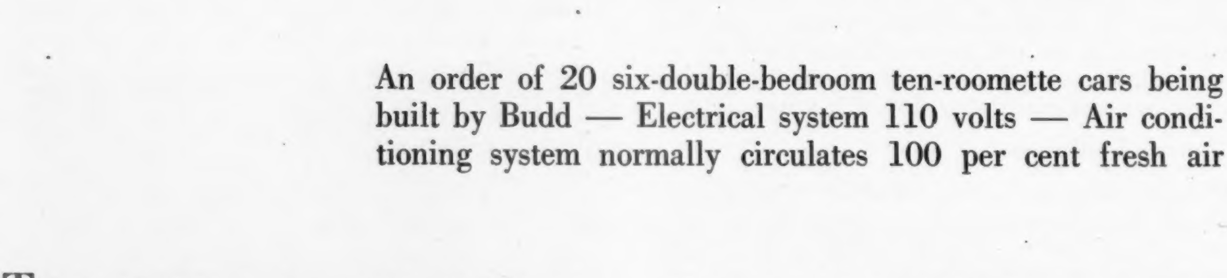
Sleeping Cars for The Norfolk & Western

An order of 20 six-double-bedroom ten-roomette cars being built by Budd — Electrical system 110 volts — Air conditioning system normally circulates 100 per cent fresh air

The Norfolk & Western is now taking deliveries of 20 six-double-bedroom and ten-roomette sleeping cars from the Budd Company. The cars are of Budd stainless-steel Shotweld construction, with variations from the customary exterior. The side sheathing below the windows has a slightly convex smooth panel of Cor-Ten steel, while the letterboard is covered with a smooth stainless-steel sheet which is applied over the corrugated roof sheet. The skirt below the side of the car is also a smooth curved sheet of stainless steel. Ends, sides and skirts are painted N. & W. standard Tuscan red. Gold stripes are applied at the top of the letterboard and at the bottom of the side panel. The lettering is in gold. The roofs are finished in dark brown and the trucks in dark green.

The cars are similar in interior arrangement to the six-bedroom ten-roomette cars furnished by Budd for the "California Zephyr." The bedrooms are in pairs, one transverse and the other longitudinal, with a folding partition between so that they may be joined to form a master bedroom. The beds in the roomettes are reduced in width toward the foot so that they may be raised and lowered without opening the doors.

The principal underframe member is a stainless-steel center sill with a cross-section area of 18.4 sq. in. Stress-relieved end underframe units consisting of the body bolster, draft-sill extension, including the draft-gear pocket, and other adjacent parts, are fabricated of low-alloy high-tensile steel and assembled by



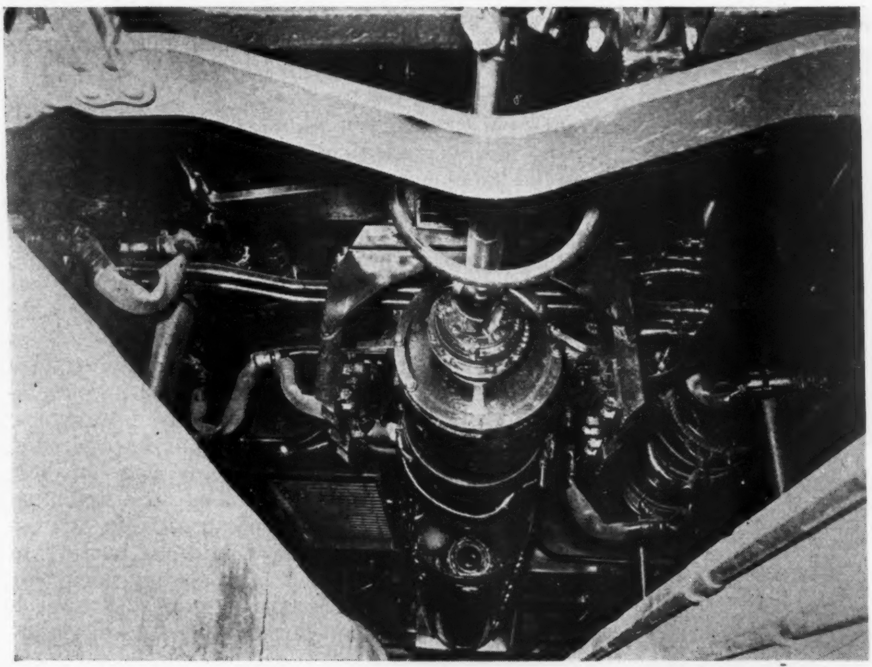
Arrangement of bedrooms and roomettes

welding. The end sills are steel castings. These units are connected to the side sill by a shear panel consisting of the floor structure and, together, are strong enough to develop the strength in collision of the longitudinal underframe members other than the center sill.

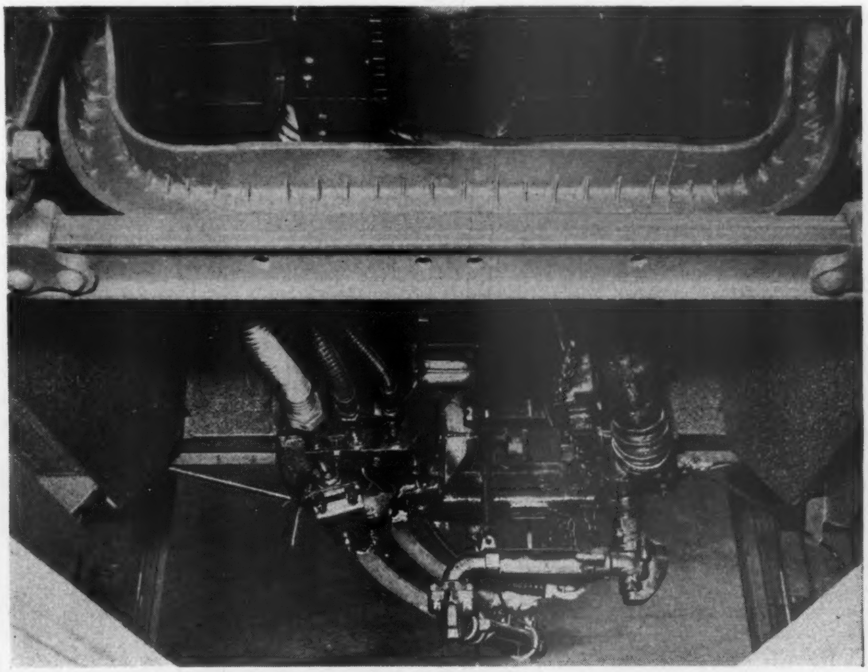
A stainless-steel subfloor is formed by extending the bottom flanges of the transverse channel floor members which are welded together to form a continuous closure. The upper floor consists of key type corrugated sheets extending lengthwise of the car and covered with Tucolith. This is surfaced with 3/16-in. gray marbleized rubber tile and the carpet laid on a 1/4-in. rubber carpet pad. Toilet floors throughout are surfaced with ceramic tile.

The side structure is a load-carrying member of truss form. The posts are normally located at the sides of the window openings. Where the window spacing is irregular, short non-structural posts are added.

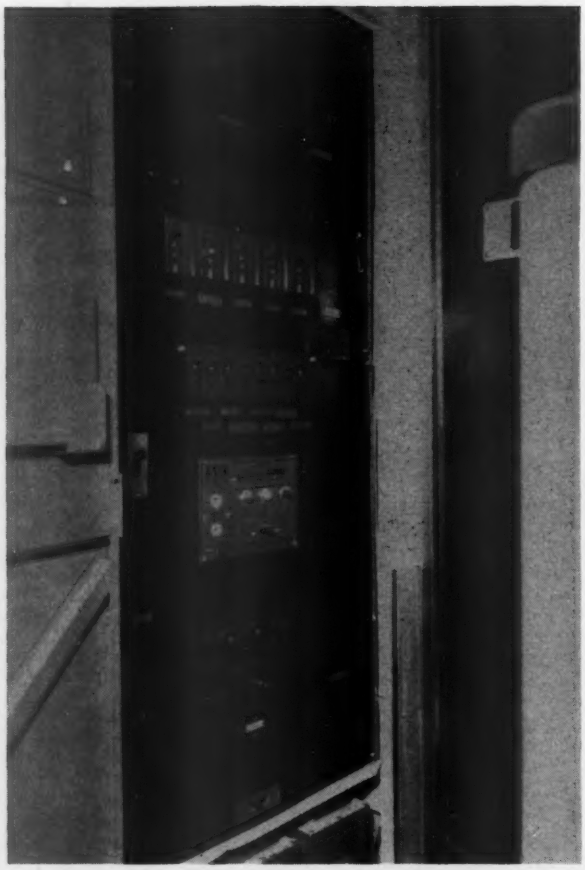
Collision posts are of high-tensile stainless steel. Their lower ends are welded to stubs on the top of the cast-steel end sills and they are securely tied into the roof structure at the top. These posts have a col-



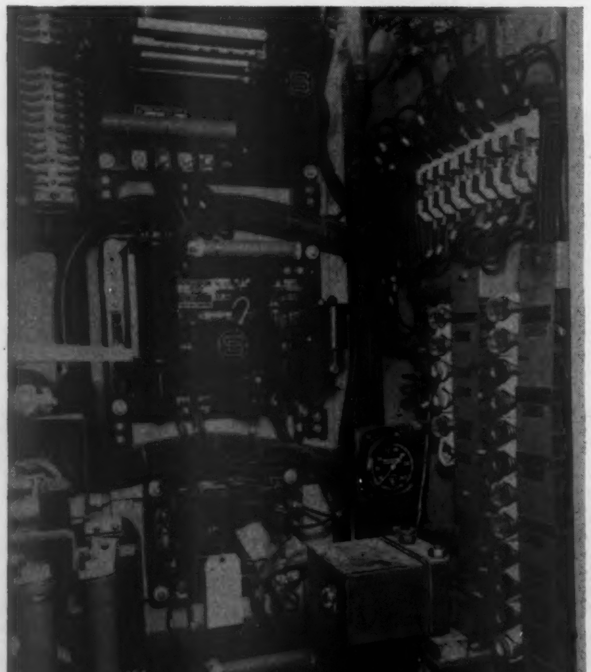
One of the 15-kw. 150-volt d.c. generators in place under the car—The G.E. inverter is shown at the right



Rear view of the steam-heat, air-brake, signal, and straight air control connections taken from under the platform



The switch locker across the aisle from the porter's section



Inside the regulator locker

lision shear strength of 900,000 lb. at the point of application to the underframe and 300,000 lb. 18 in. above the floor level.

There are eight jacking pads under the car, one near each body end post and one under each end of each bolster. Holes in the upper portion of the collision posts are provided for lifting the car by insertion of the crane hook in case of accident.

The roof is covered with stainless-steel sheets, with ½-in. rectangular longitudinal corrugations, which are welded to the Z-section cartines. Flat plates welded to the under side of the corrugated sheets reinforce the roof at the ends. Two exterior purlines, which connect to the tops of the end collision posts, reinforce the roof longitudinally.

The cars are insulated with 3-in. Ultralite Fiberglas in the roofs, vestibule ceilings, side walls, end walls and floors. A ⅛-in. coat of Insulmat is sprayed on the floor pans. Fiberglas 1-in. thick is applied to the main air-distribution duct and plenum chamber, and ½-in. of the same material covers the branch air-supply ducts.

Windows are Adams & Westlake breather type. Glass is set in rubber glazing strips applied from the outside of the car. The outside panes are ¼-in. Solex plate glass and the inside ¼-in. laminated safety glass. A removable emergency sash is installed in one passageway window opposite the door to a transverse bedroom, and another in the window of that bedroom.

The air-conditioning and heating systems in these cars operate in conjunction with an air-distribution system which circulates 100 per cent fresh air, except under extreme weather conditions tending to overload the heating or overhead cooling units. Air is delivered from the main distribution duct to each roomette and bedroom through branch ducts terminating in Anemostats. Individual temperature control, ranging from 65 to 80 deg., is available in each room.

The heating is the Fulton-Sylphon system using copper-fin radiation in stainless-steel ducts along the floor at the side walls and an overhead heating coil included as a part of the evaporator unit of the air-conditioning system. Small reheat coils are inserted in each branch air-supply duct. A single control in each room determines the temperature in the room by controlling the liquid pressure in two sylphon units which, in turn, control the admission of steam to the floor radiator and the overhead reheat coil.

During the cooling cycle the same control handle regulates the room temperature by controlling the admission of steam to the overhead reheat coil only. Change from the heating to the cooling cycle or vice versa is automatic, based on the temperature of the air before it reaches the evaporator unit of the air-conditioning system. This operates to close or open the main steam valves of the floor heat system and of the evaporator radiator, and to start or stop the refrigerant compressor.

Each car has a Frigidaire electro-mechanical air-conditioning unit with a nominal refrigerating capacity of seven tons and a maximum air circulation of 1,600 cu. ft. per min. The compressor is driven by a dual motor of 10-hp. capacity operating at 126 volts d.c., and 15 hp. operating at 220 volts, three-

phase, 60 cycle a.c. Evaporator and condenser fans are driven by 220-volt, three-phase, a.c. motor. The automatic damper which recirculates 50 per cent of the air in extreme weather conditions operates in two positions only. It is controlled during the cooling cycle by a pressure switch on the suction side of the air-conditioning compressor and during the heating cycle by a thermostat placed in the air inlet duct.

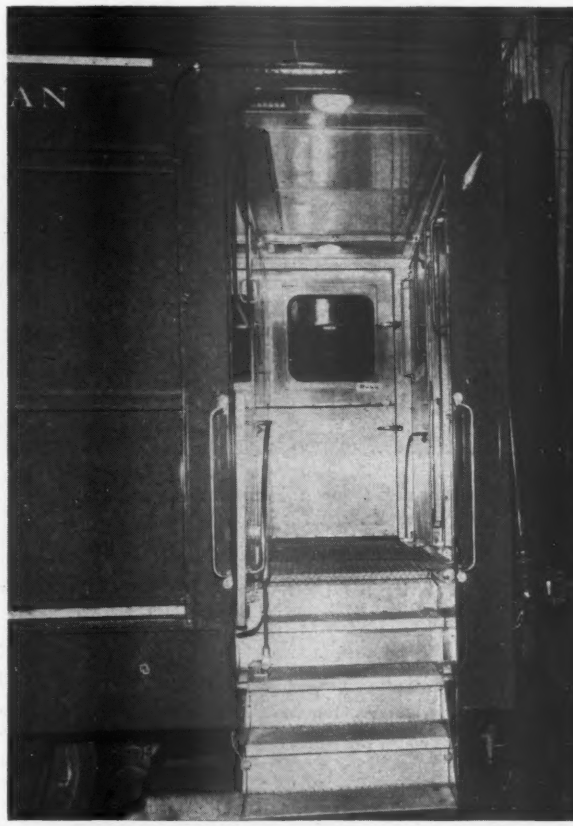
All exposed water piping and all underfloor piping except the steam train line is copper or brass with sweat fittings. All exposed piping is chrome plated. The steam train line is 2½-in. extra heavy steel pipe with welded joints. Connectors are 2-in. Vapor metallic type. Steam lines are insulated with 1 in. of Wovenstone.

The fresh-air intake is through grills in the sides of the roof at the vestibule end of the car. After passing through American air filters adjoining the grills on each side of the car, it passes through an Electro-Airmat unit before entering the plenum chamber. Exhaust air from the sleeping rooms is collected through grills in the ceilings of the rooms into an exhaust duct and is discharged at each end of the car by exhaust blowers of sufficient capacity to handle the entire volume of circulated air, except for the amount exhausted through the general toilet. A separate fan-driven exhaust ventilator draws air from the general toilet through the regulator locker.

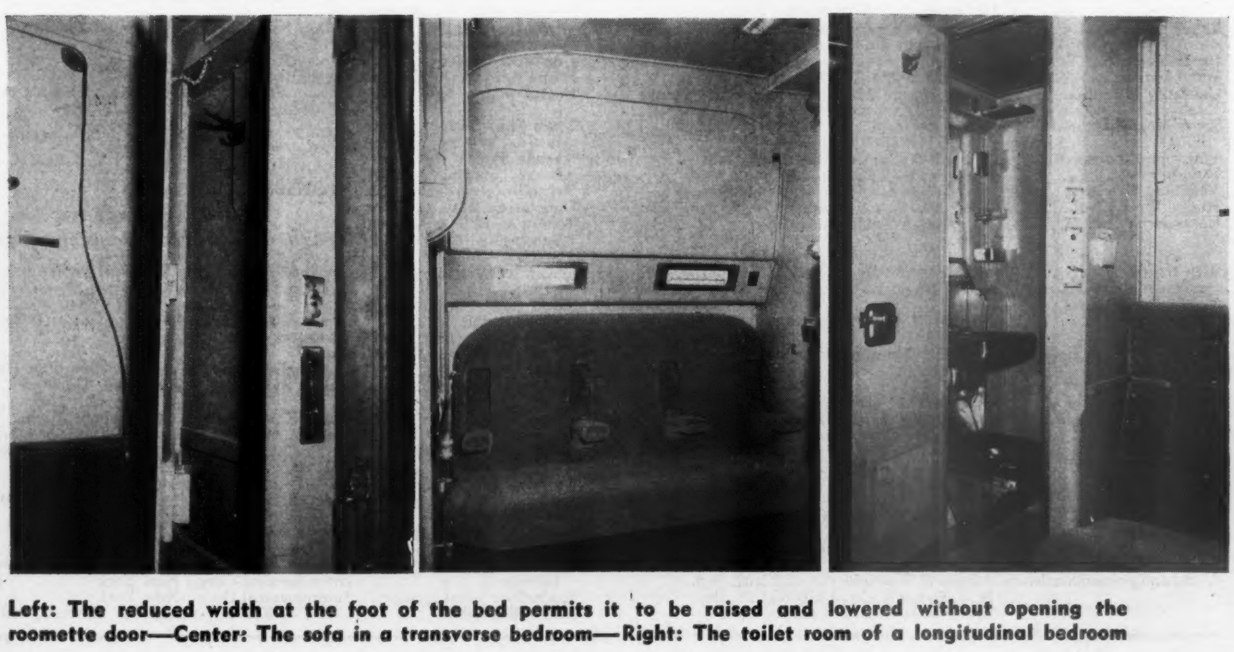
The main air exhaust at the vestibule end of the car is through grills in the vestibule. This exhaust serves to develop a slight differential pressure in the vestibule which tends to seal out dust. In cold weather the exhaust air modifies the vestibule temperature.

The temperature of the corridors is controlled by a Fulton-Sylphon thermostat which regulates the admission of steam to the fin-tube side radiators.

Electric power comes from two 15-kw. d.c. generators with unregulated voltage ranging from 90 to 160 volts. Each generator is operated by a Spicer drive. Three-phase, a.c., 230-volt, 60 cycle power is developed by an amplydine booster inverter rated 5 kw. at 80 per cent power factor. It receives its power from the 110-volt d.c. power supply and it is equipped with a reduced-voltage starter and static regulator. The 1,000-va. transformers provide 110-volt a.c. current for power and lights. Batteries are 88-cell A12H Edison arranged in four boxes per car. Fluorescent



Smooth side panels and letter board characterize the Norfolk & Western sleeping cars



Left: The reduced width at the foot of the bed permits it to be raised and lowered without opening the roomette door—Center: The sofa in a transverse bedroom—Right: The toilet room of a longitudinal bedroom

lights operate at either 230-volt a.c., or 110-volt a.c. All incandescent lights are on 110-volt d.c. circuits supplied through a Safety carbon-pile regulator.

Fulton-Sylphon valve for a branch duct radiator

Cars are equipped with two-wire, d.c. train lines and 200-amp. trainline jumpers.

The trucks are General Steel Castings equalizer type, equipped with coil bolster springs, coil equalizer springs, and longitudinal bolster anchor rods. The axles are for 6-in. by 11-in. Hyatt roller bearings. The trucks for 15 of the cars are fitted with Unit-cylinder clasp brakes operated by two cylinders, one on each side of each truck. The trucks for the other five cars have Budd Model CF disc brakes.

Rubber pads are placed underneath the side bearings and are used as bolster end bumpers. Fabreeka pads separate the ends of the equalizers from the journal boxes and are also under the center plates and under the lower ends of the equalizer springs.

The air brakes are the HSC type furnished by Westinghouse, with decelostats. The equipment includes the D22-BR control valves with electro-pneumatic straight-air control and individual speed governor.

These cars are fitted with Type H tightlock couplers and the uncoupling mechanism operates from both sides of the car. Draft gears are Waughmat Type WM-6-DP.

The total weight ready to run is 143,380 lb., of which 40,160 lb. is accounted for by the trucks including the generator drives.

PARTIAL LIST OF MATERIALS AND EQUIPMENT ON THE NORFOLK & WESTERN SLEEPING CARS

Truck frames, holster and spring plank; body center plate	General Steel Castings Corp., Granite City, Ill.
Truck center pin	W. H. Miner, Inc., Chicago
Swing hanger pins	Manganese Steel Forge Co., Philadelphia, Pa.
Couplers	(15 car sets) Buckeye Steel Castings Co., Columbus, Ohio (5 car sets) National Malleable & Steel Castings Co., Cleveland, Ohio
Uncoupling mechanism	Symington-Gould Corp., Depew, N. Y.
Draft gear	Waugh Equipment Co., New York
Wheels, axles	Bethlehem Steel Corp., Bethlehem, Pa.
Journal bearings and boxes	Hyatt Bearings Div., General Motors Corp., Harrison, N. J.
Sound-deadening material—truck	Fabreeka Products Co., Boston, Mass.
Air brakes; hose and couplers; wheel slide control; speed-governor control	Westinghouse Air Brake Co., Wilmerding, Pa.
Truck brakes	(15 cars) American Steel Foundries, Chicago (5 cars) The Budd Co., Philadelphia, Pa.
Brake shoes	American Brake Shoe Co., New York
Hand brakes	National Brake Co., New York
Car body insulation	Gustin-Bacon Manufacturing Co., Kansas City, Mo.
Sound-deadening material—floor	J. W. Mortell Co., Kankakee, Ill.
Waterproof adhesive	Acorn Refining Co., Cleveland, Ohio
Rough floor	Tuco Products Corp., New York
Vestibule flooring	Alan Wood Steel Co., Conshohocken, Pa.
Rubber floor tile	Goodyear Tire & Rubber Co., Akron, Ohio
Ceramic tile	American-Franklin-Olean Tile Co., Lansdale, Pa. Mosaic Tile Co., Zanesville, Ohio
Step treads	American Abrasive Metals Co., Irvington, N.J.
Passenger-step mechanism	O. M. Edwards Co., Syracuse, N. Y.
Vestibule enclosures—inner diaphragm	Morton Manufacturing Co., Chicago
Vestibule curtains	Adams & Westlake Co., Elkhart, Ind.
Partitions; interior doors	Haskelite Manufacturing Corp., Grand Rapids, Mich.
Blind rivets for attaching side panels	Cherry Rivet Co., Los Angeles, Cal.
Sash	Adams & Westlake Co., Elkhart, Ind.
Window glass	Pittsburgh Plate Glass Co., Pittsburgh, Pa.
Window glass — outside prism	Pressed Prism Plate Glass Co., Morgantown, W. Va.
Door operators—passenger body end doors	National Pneumatic Co., Rahway, N. J.
Door closer—general toilet; cylinder type locks	Yale & Towne Manufacturing Co., Stamford, Conn.
Locks and general hardware	Adams & Westlake Co., Elkhart, Ind. H. S. Getty & Co., Philadelphia, Pa. Loeffenholz Co., Milwaukee, Wis.
Locks, end door	Dayton Manufacturing Co., Dayton, Ohio
Window-shade mechanism	Adams & Westlake Co., Elkhart, Ind.
Window-shade material	Pantasote Co., New York
Carpet	Lees-Cochrane Co., New York
Carpet underpadding	United States Rubber Co., New York
Mohair seat covering	Massachusetts Mohair Plush Co., Boston, Mass.
Folding chairs	S. Karpen & Bros., Chicago
Card-playing chairs	Clarin Manufacturing Co., Chicago
Lighting fixtures	Luminator, Inc., Chicago
Air-conditioning system	Frigidaire Div., General Motors Corp., Dayton, Ohio
Fresh-air filters; electrostatic air filters	American Air Filter Co., Louisville, Ky.
Air distributors	Anemostat Corp. of America, New York
Door grilles	Barber-Colman Co., Rockford, Ill.
Exhaust fans	Westinghouse Electric Corp., Sturtevant Div., Hyde Park, Boston, Mass.
Heating system and control panels	Fulton Sylphon Co., Knoxville, Tenn.
Steam end valves, connectors and couplers	Vapor Heating Corp., Chicago
Steam train line insulation	Johns-Manville, New York
Batteries	Edison Storage Battery Div., Thomas A. Edison, Inc., West Orange, N. J.
Train line battery receptacles, battery jumper, brake control receptacle, brake control jumper, standby receptacles	Pyle-National Co., Chicago
Generators, lamp regulator, main switch panel and lighting switches	Safety Car Heating & Lighting Co., New York
Generator drive	Spicer Manufacturing Division, Dana Corp., Toledo, Ohio
Train line receptacle — porter's call	Albert & J. M. Anderson Manufacturing Co., Boston, Mass.
Water raising equipment, filter valves	Westinghouse Air Brake Co., Wilmerding, Pa.
Hot-water heater	Fulton Sylphon Co., Knoxville, Tenn.
Blind rivets for piping, brackets, etc.	Clark Equipment Co., Buchanan, Mich.
Hoppers	Dayton Manufacturing Co., Dayton, Ohio
Hopper seat and lid	C. F. Church Manufacturing Co., Holyoke, Mass.
Towel dispenser	Scott Paper Co., Chester, Pa.
Water coolers	Sunrock Refrigeration Co., Glen Riddle, Pa.
Cup dispensers	Dixie Cup Co., Easton, Pa.
Wall type ash receptacles	Adams & Westlake Co., Elkhart, Ind.
Paint: Exterior	Dolphin Paint & Varnish Co., Toledo, Ohio
Paint: Interior	Interchemical Corp., New York
Underfloor paint primer	Interchemical Corp., New York
Fire extinguishers	C-O-Two Fire Equipment Co., Newark, N. J.

Improving the Utilization of Steam Power*

There are many things that can and should be done to get economical performance from modern power

UTILIZATION is defined as a percentage of the total time a locomotive is actually in operation. Several factors tend to increase the average daily mileage of steam locomotives, and the ability to apply one or all of these principles determines the ultimate locomotive utilization.

To effect improvement in locomotive utilization, there must be a real desire to better past performance by every one responsible for the servicing and dispatching of locomotives. The best possible utilization of steam locomotives can be attained by delegating this responsibility to an officer with suitable staff, and hold him responsible for the results obtained. Above all other factors, there must be close co-operation between the transportation and mechanical departments.

* Abstract of a report presented at the annual meeting of the Locomotive Maintenance Officers' Association at Chicago, September, 1949.

The so-called modern steam locomotive differs from its earlier counterpart in that the boiler has more liberal proportions, the grate area is larger, combustion chamber has been extended, and ash pan volume increased. It is equipped with a one-piece cast steel bed frame, with the cylinders cast integral. It has roller bearings on all journals of the locomotive and tender. If the locomotive is to be assigned to high speed service, roller bearings on the crank and wrist pins are necessary. It is equipped with carefully designed main and side rods and reciprocating parts to reduce dynamic augment. It is equipped with complete pressure and mechanical lubrication. It has simplification of parts, co-ordination of design so as to make the parts interchangeable with other classes of locomotives, and is comparatively free of gadgets.

Where roller bearings cannot be applied to exist-

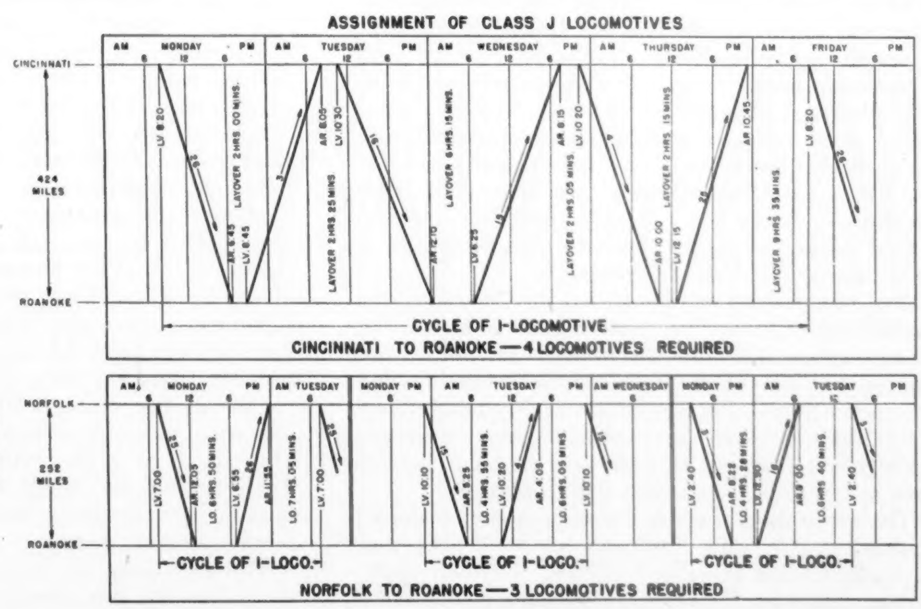
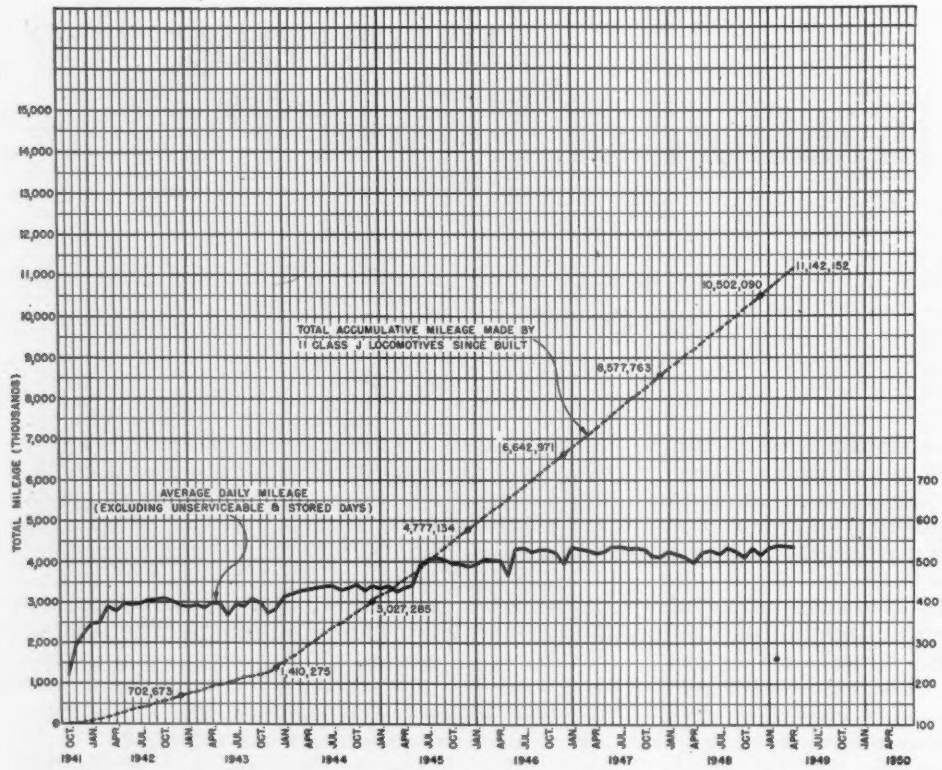


Chart showing the assignment of N. & W. Class J passenger locomotives



The accumulated and average daily mileage of N. & W. Class J locomotive is shown from date placed in service to April, 1949

ing locomotives, or the cost is not considered justified, the use of oil lubrication for driving boxes greatly increases the availability and utilization of the locomotives over that obtained when grease lubrication is used. Grease lubricated driving boxes develop wear after four to six months' service, making it necessary to drop the driving wheels, to re-fit the bearings, and to maintain lateral wear within the prescribed limits. Oil lubricated driving boxes result directly in reduced wear and maintenance of side rod bushings, which means less replacement of these parts. Driver tire life is extended at least 15 per cent. The labor involved in filling oil cellars is less than that required for grease packed journals, with a consequent reduction in the cost of lubrication.

One of the contributing factors in increasing the availability of steam locomotives is the seal welding of staybolts. It is difficult to keep staybolts from leaking because of the tremendous expansion and contraction stresses in large boilers. Fire box failures from leaky staybolts not only increase locomotive maintenance cost, but also increase the out-of-service time and reduce the average daily mileage.

The application of roller bearings to engine trucks, trailers, and in some instances, tender trucks, can be made without large expenditure. By their application, delays on the road are minimized and availability is improved.

Where steam locomotives are good for several years service, and are equipped with an old design stoker, it may be found desirable to replace the stoker with a modern type. The re-design of spring rigging and crosshead arrangement, the application of mechanical lubrication, etc., making use of modern materials and shop procedures, are profitable.

Since fuel is one of the highest items of operating expense, a study of drafting and front end arrangement will often lead to economies in the use of fuel, better combustion, and better steaming.

In locomotives designed with limited steam space, frequently water is carried over, resulting in high superheater unit repairs and low valve and cylinder packing mileage. A careful study should be made of water treatment conditions and, if found satisfactory, consideration should be given to lowering the crown sheet to provide adequate steam space. On the Norfolk and Western, such a condition prevailed on 2-6-6-4 single expansion, articulated type locomotives. This was corrected by lowering the crown sheet $3\frac{5}{16}$ in. at fire box renewals. The performance of the locomotives has greatly improved, repairs to superheater units have been minimized, foaming has been reduced, and the life of the valve and cylinder packing rings has been greatly extended.

One of the most fertile fields for economy in operation and increased capacity for a given number of locomotives is the extension of locomotive runs. These economies result from the elimination of intermediate terminals, better fuel performance, and lower operating costs.

The extending of locomotive runs over two or more divisions is a question of adequate maintenance at the dispatching terminal and proper care and handling of the locomotives enroute, rather than fuel, water, or physical characteristics of the road. The advantages gained are frequently sufficient to justify change in location of coal, water, and sanding stations, ash pits, etc., or the installation of more modern facilities to permit the locomotives to run through.

In order to eliminate coal and water stops enroute and thereby eliminate small coaling and water stations, the Norfolk and Western found it desirable to increase the coal and water capacity of the tenders of its principal classes of power. The coal space has been re-designed to provide additional capacity and to insure that all coal carried on the tender readily feeds into the stoker trough. A longer stoker screw has been applied, and stoker trough plates eliminated. This tender has a capacity of 30 tons of coal and 22,000 gallons of water. The stoker screw has a flight length of approximately 14 ft., and is tapered from 6 in. diameter at the back end to 8 in. diameter at the front end. The coal feeds from the center of the tender. With this arrangement, it is not necessary to cut down coal enroute.

Every locomotive in a district should be assigned definitely to a home terminal for maintenance, and the responsibility for its condition delegated to a designated officer. It should be the responsibility of the officer in charge of turn-around points to see that the locomotive is in such condition that it can reach its home terminal without failure or delay enroute.

The anticipation of power is of importance both to the maintenance forces in scheduling repair work and to the transportation department in scheduling the departure of trains. The daily power requirements should be watched carefully to insure that a minimum number of locomotives are in service to meet traffic requirements. In reducing the number of locomotives in service, the older locomotives should be removed first, thus giving preference to modern steam power.

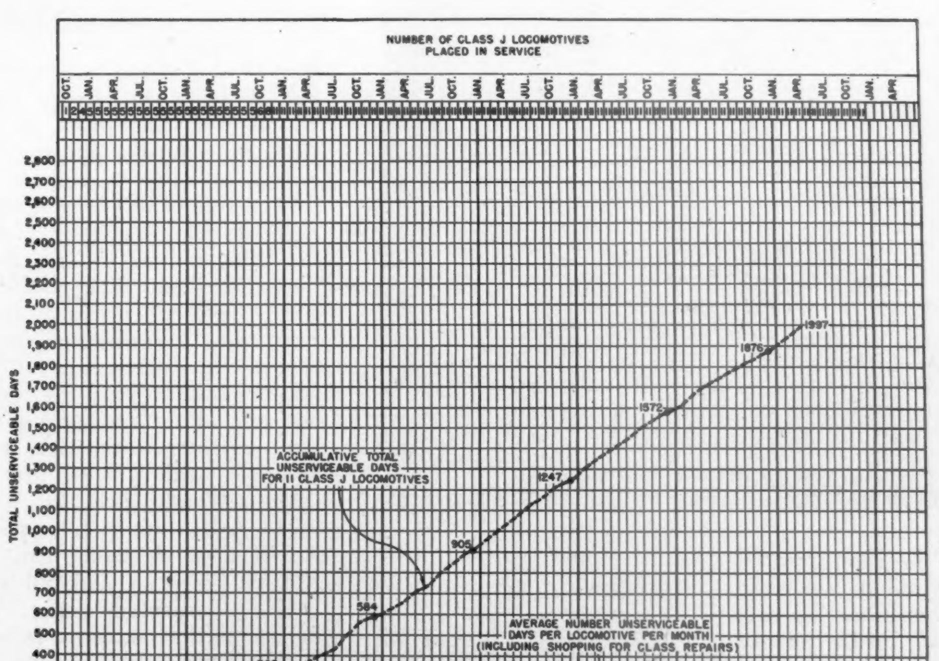
A study of schedules, together with charts, should be made to see that the best possible utilization is being attained with existing schedules. On the N. & W., the daily assignment for ten streamline, Class J, 4-8-4 passenger locomotives is 5,310 miles, or an average daily locomotive mileage of 531.

The pooling of power is a sound economic principle and should be employed to the fullest extent. Locomotives assigned to a pool normally operate between two given points, one of which is designated as the home terminal and the other the turn-around terminal. The territory over which locomotives are assigned in a pool usually covers two or more divisions, and the maintenance and inspection requirements of locomotives in the pool are co-ordinated between the master mechanics and the divisions involved. This is accomplished on the Southern Pacific by telephone and by the use of charts whereon daily movements of the locomotives are recorded.

Locomotives should be given proper maintenance attention at monthly periods, preferably at inspection time, to condition them to run to the next monthly repair time with a minimum of repairs. The inspection dates should be set up so as to take advantage of the time the locomotive is scheduled for classified repairs.

Proper scheduling of locomotives to the main shops for classified repairs is of paramount importance. A tentative shopping schedule should be set up 12 months in advance of the shopping date, so as to stagger the shopping of locomotives and to take advantage of the dates the locomotives are due for hydrostatic tests, flexible staybolt caps, flues, lagging, etc.

By definitely fixing the shopping date approximately three months prior to taking the locomotive



Record of unserviceable days, N. & W. Class J locomotives from time placed in service in 1941 to April, 1949

N. & W. redesigned tender with 30-ton coal capacity has a 14-ft. stoker screw which is tapered—How the coal feeds is shown below

in the shops, material can be made available, and the number of unserviceable days the locomotive is shopped can be reduced to a minimum. The Canadian Pacific reports that by closer scheduling of locomotives for repairs, they saved 8,500 locomotive days during 1947 and 1948. In previous years they report it had been necessary to rent locomotives from other roads to handle peak demands, and although traffic was heavier in 1947 and 1948 than in previous years, they were able to operate these years without assistance from other railroads.

The cost of coal has increased until it is now one of the largest items of steam locomotive operating expense. Unfortunately, underground mechanization of the coal mines generally results in higher ash, wider quality variations, and an increased percentage of fine slack. A better grade coal with low ash content will improve efficiency, speed up the cleaning of fires at terminals, and minimize delays on road, all of which will result in improving locomotive utilization.

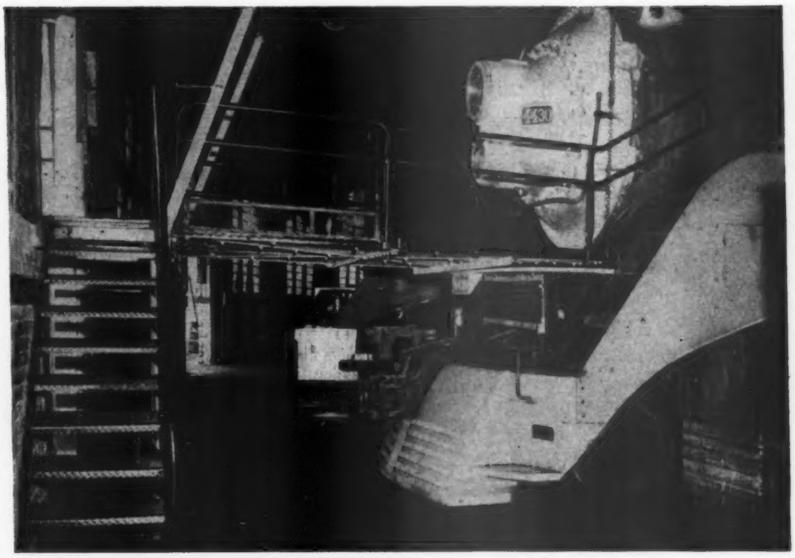
The Norfolk and Western conducted a series of tests on 2-8-8-2 locomotives and by the use of double screened prepared coal, obtained the following fuel performance per thousand gross ton miles:

Size coal, in.	Pounds fired
2 x 0	46.11
2 x 1/4	40.79
2 1/2 x 1 1/4	39.85

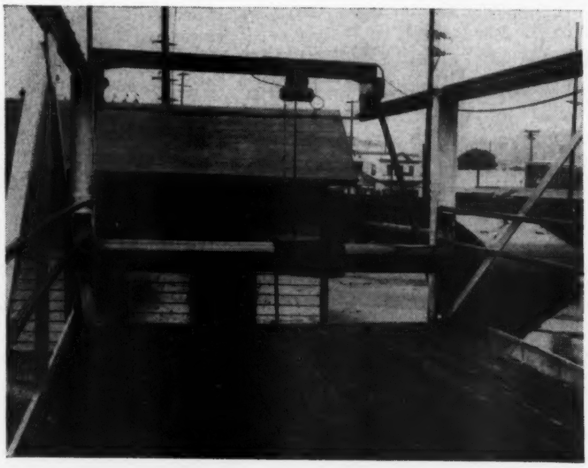
With proper treatment of boiler water, locomotive availability is greatly increased because corrosion, scale formation, and accumulations of mud and sludge are held to a minimum, thereby reducing loss of locomotive time for boiler and firebox repairs. Flue renewals and injury to flue ends from repeated caulking are reduced. Foaming is minimized and consequent road delays eliminated.

Modern servicing are a requisite to secure maximum utilization. Improvements made at the Southern Pacific Alhambra enginehouse at Los Angeles, Calif., include one stall equipped with a permanent scaffold for use when making repairs ahead of the cab and above the running board which eliminates unsafe temporary staging and saves the labor required to build standees and scaffolds.

In conjunction with the fixed scaffold, a permanent steel platform is provided for ease in removing and applying superheater units and handling front end netting, steam pipes, nozzle stands, etc. The platform has a hinged apron, which can be lowered or raised in order to connect the platform with the locomotive. The apron is operated by means of an overhead traveling crane and when lowered rests on the front running board, level with the bottom of the smoke box. The platform has hand rails, with access from either side by means of steel stairs with hand rails. It is also equipped with wire mesh guards to prevent objects from falling to the floor. It is large enough to hold the material being worked on, and still afford room for men to walk around and perform their work with safety. The platform is equipped with a steel drum or roller, 12 in. in diameter, running the full width, and operated by a low speed, 5 hp. motor equipped with transmission and reverse. A strong hemp rope coiled around the drum is used to pull out superheater units. The overhead traveling crane, which travels the full length of the platform, is used to handle material removed from the smoke box. A unit puller, equipped with a pulley, is inserted in the flues for pulling superheater units into the locomotive. The time saved by use of these facilities as compared to former methods is substantial.



Permanent steel platform for front-end work has an extension outside the house wall with power drum (shown below) for removing units



Locomotive spotters are generally used to relieve turntable congestion and accelerate repairs, thus contributing to increasing the availability of locomotives. They have also reduced man hours lost as the result of mechanics having to wait long periods to obtain the necessary spots to complete repair work.

The members of the committee which prepared this report were C. E. Pond (chairman), assistant to superintendent, motive power, Norfolk & Western; F. E. Molloy (vice-chairman), assistant superintendent, motive power, Southern Pacific; J. E. McLeod, superintendent, motive power, Chesapeake & Ohio; C. H. Spence, superintendent, Mount Clare Shops, Baltimore & Ohio; L. B. George, assistant chief of motive power and rolling stock, Canadian Pacific, and John Moe, superintendent of apprentice training, Chicago, Milwaukee, St. Paul & Pacific.

Southern Pacific steam locomotive sanding facilities at Sparks, Nev.

Attracting and Holding Engineering Graduates*

A discussion of the methods used by the New York Central in hiring and training special technical apprentices

By F. K. Mitchell†

A MAN worth hiring is one worth retaining, conversely a company worthy of making an affiliation with, is one worthy of a man's loyal, lifetime service.

Both the applicant and the company have each an inherent right to be satisfied as to how the other will measure up in these respects. On this premise, the initial conference or conference between the applicant and his prospective employer become of paramount importance. Both parties must obtain a thorough understanding of the other.

On the one hand, the employer must be convinced beyond any doubt that (1) The applicant is seeking a lifetime connection; (2) He will enjoy doing the kind of work that he will be required to do; (3) He will be able to get along with and enjoy working for and with the other men in the organization; (4) His moral and social background will make him an asset to the company in whatever position he may attain; (5) His educational background is such that he can be depended upon to acquire the pertinent knowledge his future will require him to have, and that (6) His loyalty and devotion to duty will be as unquestionable in adversity as in tranquillity.

On the other hand, the candidate must be convinced that (1) The company he is seeking employment with is a stable and sound one; (2) It offers the kind of work which he feels himself to be the best suited for and which he will enjoy doing; (3) Its rates of pay and working conditions are satisfactory; (4) Its training program is constructive and thorough; (5) It offers advancement to those who are qualified and worthy, and that (6) Its personnel is the type with which he will be compatible.

Information as important as are the above twelve items cannot be exchanged and established in a whirlwind, brief interview. Time and patience on the part of both parties are essential. From the company's point of view, it is imperative that the officer entrusted with the conference be well qualified both as to personality and knowledge of his company's requirements and needs. This information once established to the satisfaction of both parties, the hiring contract may then be signed without hesitation. Once signed the company and the employe have both added a new and valuable item to their respective assets.

The new employe should, indeed, be considered as an asset. His value to himself and to his employer will be daily increased by proper training. This fact should be made evident to him, and kept before him in an impressive manner at all times so that he will want to acquire all the knowledge and information possible about his job, his company and its problems, policies and future requirements of him.

The training and retaining of engineering graduates cannot be discussed separately. Each is the complement of the other. There must be a mutual understanding, a mutual cooperation and a mutual satisfaction involved which on one hand will inspire the engineer to get the greatest benefit from his training, do the greatest possible good for his company and to remain with the company so long as he may be physically and mentally qualified. On the other hand, the company must provide a training which will be an inspiration and permit the trainee to acquire the greatest good from it, and advancement program thereafter which will underwrite the inspiration it has created, and job security which by its actual operation will prove to him and all others in the same category that his being an asset to them is a fact and not a myth, and a retirement security which will be commensurable with the position he has acquired and the service he has rendered.

All of these things the New York Central System strives to do. The methods followed and the results which are being obtained in the equipment department are a story which may be of interest to all.

To begin with, it should be understood that the equipment department of the New York Central is responsible for the design of electric, steam and Diesel locomotives, passenger, freight and work equipment cars, power plants, shops, shop machinery and special devices; after the design is completed it

* Abstract of a paper presented at the annual meeting of the American Society of Mechanical Engineers, Railroad Division, held at Hotel Statler, New York, December 1, 1949.

† Manager of equipment, New York Central System.

is responsible for the construction of this equipment, and thereafter for its maintenance and operation. Engaged in this task are about 200 men on strictly engineering work and some 2,000 men in supervisory positions on maintenance work whose positions the new mechanical and electrical graduate could aspire to. Quite frequently also equipment department engineers and supervisors are transferred to positions in other departments, thus broadening the field of advancement materially.

Since 1901 the New York Central has had a special apprentice course designed to fit the engineering graduate for these positions. Over the years this course has varied considerably, the final system having been evolved some five years ago.

Interviews with and the hiring of engineering graduates are handled by either the manager of equipment or the general superintendent of equipment. The number of special apprentices on the rolls at any one time is held to not over 25. It is evident, therefore, that there is a broad field for the graduate from this course. To insure uniform training and a close observance of the progress of the special apprentice his assignments are controlled by the general superintendent of equipment at New York. His immediate superior during any one assignment is required to make a monthly report of his progress and capabilities to the general superintendent of equipment.

The special apprentice course imposes the heaviest physical work load on the student right at the start. He is required actually to perform work with regular mechanics and there is no attempt made to make things easy for him. If he is physically lazy, this fact will quickly be evident. The student knew this was coming before he started. He also knew that if he proved to be physically lazy the Central had no place for him. On the other hand, it will be noted that his course is varied each three months during the first two years. His interest is, therefore, never allowed to lag. The same thing is true during the first half of his last year on the optional assignment where he works and learns the running repair methods and requirements on locomotive or cars. During this period the physical work requirements are less, but the mental work requirements increase.

When the first six months of the third or last year of the special apprenticeship has been satisfactorily completed, the student is called in for another conference. The purpose this time is to review his progress and experience, ascertain his preferences and jointly decide on his assignment for the last six months of the course. This is considered an important phase in the student's education. By now he has had opportunity to see for himself what the maintenance problems are on all types of equipment, to learn the work and production methods followed, and to establish to his own satisfaction which type of work he is best qualified for and would be the most satisfied at. Also management has learned his limitations, his capabilities, and natural bent. Together they decide on how he shall specialize during the final phase of his training. The moment of this decision is impressed upon him and the opportunities before him are pointed out.

Heretofore he has been a student mechanic. Now he becames a student supervisor. He carries out special enginering and managerial assignments given him by the officer to whom assigned, and starting in a small way on supervisory jobs of minor importance begins to obtain experience in handling men. As he progresses the importance of these assignments becomes increasingly greater, as do the responsibilities he is allowed to assume. By the time he finishes his special apprentice course both he and management are not only aware of whether he has the required qualifications but as to whether he is in the right groove.

When the special apprentice course is completed, the education of the engineering graduate is not complete. For approximately a year thereafter his assignments are on jobs primarily of an instructive nature. They cover essential work, but of such a nature as to be highly educational. The rates of pay are high enough to be an attractive promotion over the rate paid during the last year of the special apprentice course.

Usually at about the end of the fourth year of employment, he takes a place in the ranks of the supervisors or the engineering staff as his capabilities and desires indicate him best fitted for. He now must take his chances of promotion along with the 2,200 other supervisors and engineers, some of whom have had the same training advantages as he, many of whom have come up the so-called hard way. But his chances of success are good for he has a thorough knowledge of the railroad and its equipment. If he is in the engineering division, his design ideas are good because he knows the service the equipment he is designing must perform. If he is in the maintenance division, his experience has already shown him how maintenance must be done to insure good performance. In either case he has contacted many of those on the road with whom his daily work will bring him in contact and knows how to get along well with them.

Where he goes, the heights he attains, is a matter which he knows is entirely up to him and the way he handles each succeeding position or job with which he is entrusted. He knows also that there is no limit except that imposed by himself as to the height he can climb during his railroad career.

Why then, should there be any reason for him to leave the service of a company which has devoted so much time and money to his education and which offers so great an opportunity to him for his future?

The answer to this question may be found by a search of the records and case histories of those who have entered New York Central service as special apprentice.

The first graduate from this course was employed in 1901. Since that time 150 engineers have been graduated from our special apprentice course, and as of this date there are 84 graduates still in our official family and 19 undergoing training as special apprentices.

[Included in this paper were tabulations showing the names of the colleges from which special apprentices on the New York Central were graduated; a chronological list of the 66 men no longer in the

railroad's service and a similar list of the 84 men remaining in the service. These two lists show the special apprentice's first position after completing his apprenticeship, the position five years and ten years later and the position held upon leaving the company's service or, if still in service, at the present time. These lists show the individual record, including the salaries, of the postions held.—EDITOR]

Of 66 men who severed connection with the New York Central, 39 were engaged in straight engineering work and 27 in maintenance work. The salaries of this group in their first position after completing apprenticeship averaged $175 per month; five years after graduation from special apprenticeship only 21 of these men remained in service and their average salary was $255 per month; ten years after graduation only 13 of these men remained in service and their average salary was $304 per month; 42 of these men quit after remaining less than five years in service and their average salary at the time they severed connection with the railroad was $188 per month.

Of a group of 84 men, still in the company's service, 51 are in the maintenance section of the equipment department, 31 in the engineering section of the equipment department, one is assistant general purchasing agent, and one assistant general manager. The average salary in their first position after graduation was $197 per month; the same men at the end of the first five years after graduation salary average was $265 per month; after ten years their salary average was $325 per month and at the present time their average salary is $528 per month.

The average length of service of these men is 19 years; of these ten have 30 years service or more; 36 have between 20 and 30 years service; 23 have between 10 and 20 years service, and 15 with less than 10 years service. The maximum length of service is 43 years and the minimum a fraction over three years.

Between 1901 and 1920 but few special apprentices were employed. The highest number per year was three and in many years none were employed. During that time the value of the special apprentice to the railroad company had evidently not been thoroughly established. Neither had a good special apprentice training program been worked out. Much of the hiring was apparently done on the basis of family connection and the placement of these men depended largely on their acceptance by the few men in authority who were convinced that the railroad company needed engineering graduates for any jobs other than strictly academic engineering work. On the other hand, in spite of these facts, some very fine engineers began to receive recognition and make a place for themselves. As a result, the attitude toward employment of men with an engineering background gradually changed.

During the next ten years, 1920 to 1929, the average number of special apprentices graduated was about seven per year and a peak of fourteen was reached in 1923.

The depression in business which followed not only stopped the hiring entirely, but resulted in a large number of former special apprentices either being furloughed, dropped from the rolls entirely or resigning because of the uncertainty which continued lay-off and salary reductions created.

In 1934 with business improved and conditions generally more stable, engineers again began graduating from the special apprentice course and for the next eight years, 1934 to 1941, the number graduating annually averaged 5½ with a peak of eight. During the same period, however, eleven special apprentice course graduates severed their connection with the railroad primarily because of there being a disparity of rates of pay between those offered by the railroad company and those paid by other industry. Furthermore, the special apprentice training course then in effect was neither thorough nor attractive, and the practice of furloughing them when business was bad was discouraging.

Post-War Condition

Then followed the war years, during which it was practically impossible to hire a young man because of military requirements. Not only was hiring at a standstill, but at the same time most of the special apprentices and younger special apprentice course graduates either were drafted into the armed forces or enlisted therein. Almost without exception these men were commissioned as officers. During their military service a large number of those who had not finished their special apprentice courses were married and by the time the war was over had obligations which no longer made the rate of pay for special apprentices attractive to them. Consequently but few returned. During this period, therefore, the hiring rate was the lowest and the separation rate the highest in the almost 50 years of existence of the special apprentice system on the New York Central.

While these reverses were being suffered the Central's officials were studying the situation carefully and through that study realized that they must

(1) Make the hiring rates for special apprentices more attractive;
(2) Improve employee relation with the special apprentices;
(3) Improve their training course;
(4) Improve their chances of advancement;
(5) Avoid lay-off of these men if at all possible during lean times;
(6) Not overhire so that good jobs would be available to those who qualified for them;
(7) Minimize the necessity for moving the apprentice from one point to another and compensate him for his moving expense when it became necessary to move him, and
(8) Make him a part of management from the time he was hired.

To accomplish this it was plain that it would be necessary to adjust the hiring rates because of the disparity which had long existed between them and those paid by other industries. Furthermore, indiscriminate hiring without regard to the company's needs, or the possibility of later placement or without a complete understanding of all pertinent factors being had by both parties evidently was a procedure which had been responsible for later misunderstandings and dissatisfaction. All too often we found

that engineering graduates, after being hired, were forgotten and allowed to struggle along as best they could without counsel or consultation. Often they were early sidetracked onto jobs the local management needed to fill at the moment and when the three-year training period ended had no general training at all. Too often no one knew what their qualifications, capabilities or natural bents were nor gave the least consideration to their personal desires.

There was no understanding or agreement with the shop crafts organizations which permitted the special apprentice to do actual mechanic's work and no provisions made with the supervisors to permit them to gain experience as such. They, then, were of course more often observers than learners and were consequently persona non grata with the shop employees and supervisors as well. Agreements with the parties concerned were recognized a necessity and ultimately consummated.

Special apprentices were generally furloughed when business recessions occurred and payroll economies ordered. They were moved from point to point on the System without plan and quite often because some local official wanted special work done and figured it was the easy way to get the help he wanted. Not infrequently they were required to make such moves without compensation for their moving expenses and with no increase in pay rates. To top this all off there were many cases where special apprentices finished their three year course and found there was no job for them. They were either dropped or asked to stay on a so-called extended special apprentice rate, which of course was disappointing and no inducement.

All of these adverse factors certainly did not create a good reputation for the New York Central's special apprentice training system. It could not be expected that graduates from such a course would generally try to influence undergraduates from their alma mater to aspire to follow their footsteps. Naturally, too, university and college personnel and placement officers were less than enthusiastic about recommending to the student that he apply to the Central for employment on graduation. As a result in many instances other industries got the cream of the crop, we took what was left and our retention rate was low.

The present system and training course was devised and went into effect at the close of the war. The results have been thus far highly satisfactory. Since the war 24 young engineers have been graduated and taken over good positions. Nineteen (19) undergraduates are being trained and their prospects of advancement after graduation are good. Furthermore, there are numerous applications on file from which to fill our requirements and new applications are coming in currently.

Since putting our new system into effect our retention rate is approximately 80 per cent. I am happy to say that apparently we have solved not only the problem of attracting the engineering graduate to the railroad, but of retaining them with us. I am confident that any railroad can do the same or a better job.

REQUISITES FOR SPECIAL APPRENTICE COURSE

1. Must be graduate of mechanical engineering or mechanic electrical course in an accredited college. Some practical experience desirable, but may be waived. Interview required.
2. Age—under 26. Good physical condition, sight and hearing, and good moral character. Must have an earnest desire to enter training course.
3. Course is three years. Consists of experience on the regular work in the shops, engine terminals and repair yards, with a change as nearly in accordance with the program under Paragraph 4 as circumstances permit.
4. Training schedule for special apprentices is outlined below. Those assignments shown in the first and second years are required, but the order of the assignment may be changed as conditions make necessary, although the order shown is considered to be the desirable sequence:

First Year

Locomotive Shops	
Erecting Floor	3 Months
Machine Shop	3 Months
Boiler Shop	3 Months
Blacksmith Shop	3 Months

Second Year

Passenger Car Shops	3 Months
Freight Car Shops	3 Months
Electric Shop (Electric locomotive and M. U. Car equipment)	3 Months
Diesel-Electric Shop	3 Months

Third Year

First Six Months—Optional assignment to engine terminal, passenger or freight repair yard.

Second Six Months—Special assignment with one of the following, including filling of temporary supervisory vacancies, selection to be made in joint conference with student and management:

- Supervisor of locomotive and fuel performance
- Engineer of tests
- Engineer of motive power, rolling stock or electrical equipment
- Master mechanic
- Division general car foreman
- Shop superintendent; either locomotive, car, or electric shop

Those special apprentices, who, prior to starting their special apprenticeship have served time as regular apprentices in any of the shops or capacities outlined above, will be credited for such time on the basis of the number of days actually spent on the work involved.

5. No pay for overtime allowed. Refund for expenditures when on detached duty is permitted. Two weeks vacation per year, with pay, is allowed, after the first year.
6. Rate of pay:

	1st 6 Months	2nd 6 Months
First year	$277.50	$285.50
Second year	293.50	301.50
Third year	309.50	317.50

7. At completion of the Course, permanent assignment will be made to a place which the graduate can fill for the best interest of the Company, and with credit to himself.

ELECTRICAL SECTION

Lehigh Valley Installs Vapor Degreaser

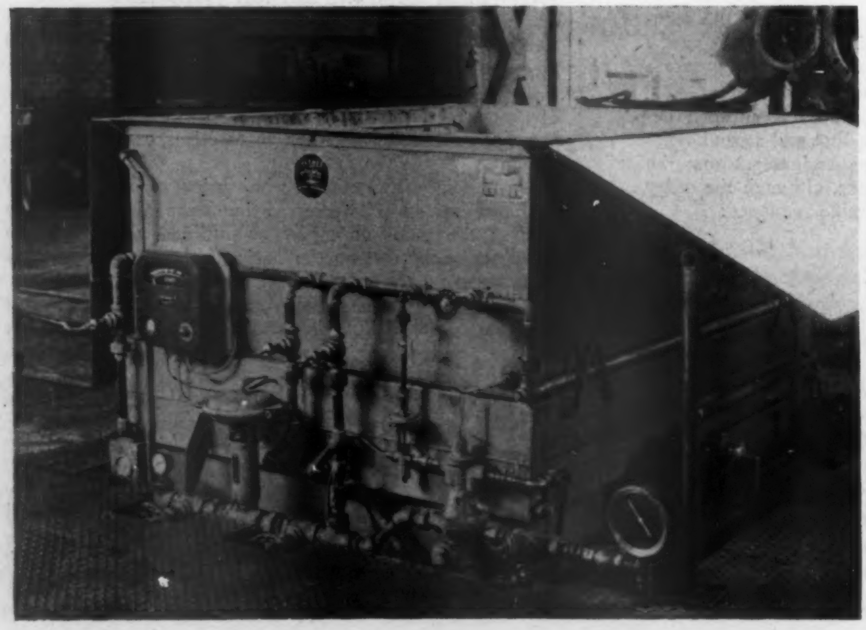
Intended primarily for service in the electrical shop, the device is also used extensively for cleaning of a variety of metal parts

A VAPOR degreaser has been installed in the Lehigh Valley's electrical shop at Sayre, Pa. Its primary purpose is Diesel-electrical locomotive maintenance, and in this capacity it is currently being used to degrease traction motor armatures and frames, and also to clean motor pinions, gear cases, air and oil filters, cylinder heads, spring assemblies and many other metal parts. It is also used for shop motors and other electrical equipment which is overhauled in the electric shop.

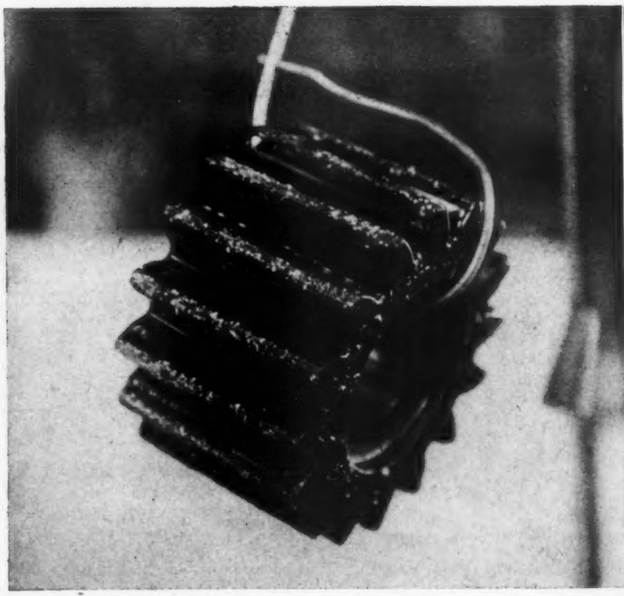
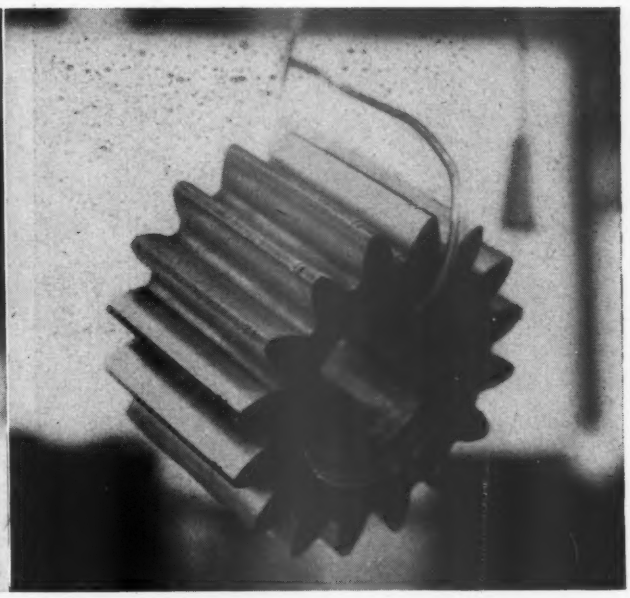
Lighter weight parts are placed in the degreaser by means of an air hoise mounted on a jib crane. The shop traveling crane is used for the heavier parts, such as traction motor frames.

The degreaser consists primarily of a tank placed in a pit in the shop floor. While it is in use, liquid solvent in the bottom of the tank is kept boiling by means of steam pipes submerged in the liquid. The vapor, which results from the boiling, rises to almost fill the tank, but is kept from overflowing the tank by condenser coils carrying cold water which are located inside the tank near the upper rim. The solvent used by the Lehigh Valley is Perm-a-clor, which is a bighly stabilized trichlorethylene, and which boils at a temperature of 188 deg. F. It is non-inflammable, and the work emerges clean and dry without supplementary heating. Only pure distillate and vapor come in contact with the parts being cleaned.

Parts to be cleaned are suspended in the hot vapor for periods of one to fifteen minutes. Since they are at room temperature when immersed, the vapor condenses rapidly on the parts, and the resultant condensate streams off of them, carrying the dissolved grease and dirt with it. A motor-driven pump, with



Vapor degreaser in the Sayre, Pa., shops of the Lehigh Valley

Left: A traction motor pinion before cleaning—Right: Traction motor pinion after 1½ minutes treatment in the degreaser

pushbutton control supplies liquid solvent for a hand-operated spray which is used to flush the part being cleaned just before it is removed from the tank.

The size of degreaser, chosen by the Lehigh Valley, employs a tank which has a clear opening 72 in. long by 48 in. wide, and has an available vapor depth of 60 in. The rated production capacity is 24,000 lb. of steel per hour. This means that this amount of steel can be put through the tank in one hour without reducing the level of the vapor to a point below the condenser coils.

The distillate from the condenser is caught in a gutter from which it drains through a water separator into a storage tank. This storage tank is divided to provide a separate compartment for the collection of solvent distillate used in the flushing operation. This sump, in turn, overflows into the main compartment of the storage tank, the solvent finally returning to the boiling chamber of the machine, thus completing the solvent cycle.

Grease and dirt, removed from the parts, fall through a grating into the bottom of the tank. When the level of dirt becomes sufficient to reach the heating coils, the bottom of the tank is cleaned. This is accomplished by first closing a valve between the storage tank and the main tank, and continuing the boiling until the main tank is empty. The steam is

A traction motor frame comes out of the tank after five minutes immersion—Immersion time for class A insulation is limited to five minutes—Time for class B insulation may be extended to ten minutes

Operators making cleaning tests while man with stop watch keeps time

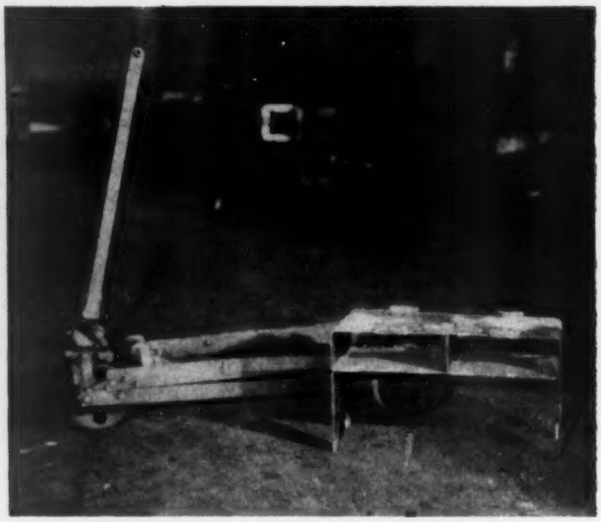
then turned off, the heating coils are removed through a cleanout door at the bottom of the tank, and the dirt scraped from the bottom.

The estimated requirements per 8-hr. day of continuous operation are: water—7,600 gal.; power—0.5 kw.-hr.; heat—3,760 lb. of steam at 15 lb. per sq. in.

The degreaser was supplied by the Detrex Corporation, Detroit, Mich.

Interior of the degreaser tank showing the condenser coils and a traction motor armature suspended in the vapor

"Private" Skids for Battery Handling



Skid and truck used for handling battery trays

Individual skids have materially eased the work of handling and overhauling Diesel-electric locomotive batteries in the Erie shop at Marion, Ohio. The skids which are fabricated from $\frac{1}{4}$-in. welded steel plate, are the same height as the floor of the locomotive battery box. The height is 17 in., the width 14 in., and the length $30\frac{1}{2}$ in. To give the skid the necessary stiffness and at the same time allow for handling the skid with a lift truck, the skids have a second horizontal plate, $3\frac{1}{2}$ in. below the deck plate, with a vertical $\frac{5}{16}$-in. member at

When the battery tray is on a skid the top of a battery is at a convenient working height

Three skids and trays on a hand lift truck

A half an hour in the bake oven makes the removal of seals easy

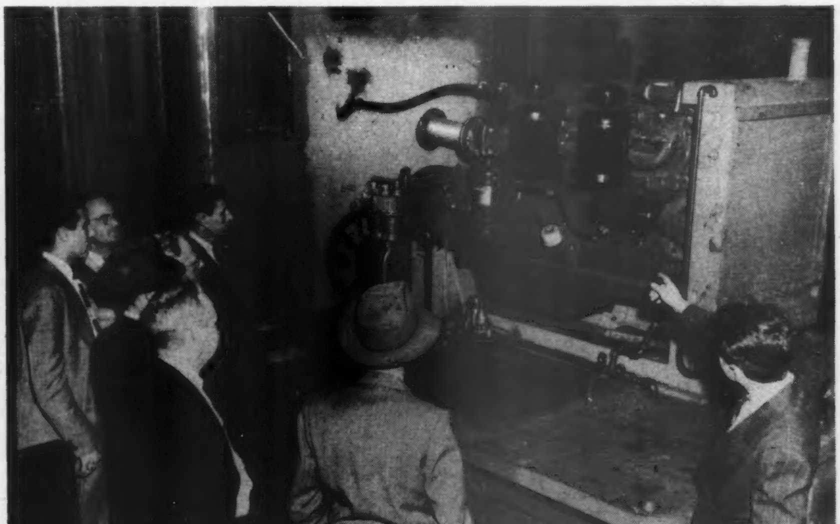
the center, welded to the stiffener and deck plate. Four flanges, or lips, 1 in. high and 4 in. long, are welded to the edges of the deck plate, to keep the battery from slipping sideways, or rotating when it is on the skid.

A manual lift truck is used for handling one, two or three batteries. The procedure for changing out batteries consists of putting two loaded skids and one empty one on a truck. One tray is slid from the battery box onto the empty skid. The truck is then moved along the width of one tray, and the tray on the next skid is slid into the empty space in the battery box. The same procedure is used for the remaining trays.

At all times that a battery tray is out of the locomotive, it remains on its own "private" skid. The height of the battery on the skid makes work on the battery convenient. The work done normally consists of resealing battery covers, and occasionally replacing a broken jar.

For renewing the cover seal, the battery is placed in the baking oven with the temperature set between 90 and 100 deg. F. In a half, to three-quarters, of an hour, the seal is soft enough so that it may be removed easily with a putty knife. This eliminates the use of an open flame which is always hazardous for battery work. The new seal is poured from a coffee pot.

Instructor points out features of partly completed G.E. 25-ton switching Diesel-electric locomotive at the General Electric Company's Diesel-electric school in its Erie, Pa. plant—The company's Locomotive and Car Equipment Divisions offer instruction in operation, inspection and maintenance of G.E.'s switching locomotives



A. C. Power for Passenger Cars

The advantages of motors without commutators, as well as fluorescent lighting, and use of standardized 110-volt accessories, have created a constantly increasing demand for alternating current power

*By L. B. Haddad**

THE a.c. power requirements which ten years ago consisted of a small fluorescent lighting load of a few hundred watts, have increased considerably in the modern type of railroad passenger car. They now include a lighting load, as well as a motor load, which may total as much as 6.4 kw.

The load may vary between 4.0 and 6.4 kw., the maximum at present being 6.4 kw. at 80 per cent power factor. It consists of fluorescent lamps and induction motors, usually three-phase. The load may include the air circulating fan motor and the condenser fan motor. Because of the large load, it is important that the apparatus be as efficient as possible.

Both the frequency and voltage should be properly regulated under all conditions of loading, temperature and input voltage variations. The maximum specified d.c. input voltage range is 95 to 160 volts for nominal 115 volts and 54 to 90 for nominal 64 volts.

For easy and cheap maintenance, it is essential that it be rugged in construction, simple in design and of a type familiar to railroad men. For long life, it is very desirable that the apparatus run cool.

For stability of operation, it is an advantage to have the regulating equipment act with the minimum of interdependence. Furthermore, such independence of action allows easy understanding of the operation of the equipment, and simplifies the analysis of trouble when it occurs.

Another requirement is the ability of the machine to start a 3-phase induction motor, or motors, up to a total of two horsepower, without causing excessive dimming of the fluorescent lamps for an appreciable length of time. Obviously, the value of equipment built for this type of application depends on the manner in which it meets the above requirements.

To meet this growing need for larger equipment, the Safety type MG-19 motor alternator was developed, based on designs which had already been proved in Navy service. It is rated 7 kw. at any power factor between 80 per cent and unity, 230 volts a.c., three-phase, 60 cycles, 1,800 r.p.m. with 64 or 115 volts d.c. input. Because of the larger size of commutator required, the rating of the 32-volt machine in the same frame is 5.0 kw. This type of machine is externally regulated, the complete installation consisting of a motor alternator, a step starter, a carbon pile voltage regulator and a carbon pile frequency regulator.

The construction of the motor alternator is practically standard for this type of equipment. The rotating member consists of the d.c. motor armature and the alternator armature mounted on a common shaft on sealed ball bearings. These are four d.c. brushes and six a.c. brushes, two of each set being connected in parallel. The motor armature is wave wound.

The motor field structure consists of four poles, four shunt coils and four single turn series coils wound around the shunt coils and taped to them.

The alternator field structure consists of four pole pieces, four shunt coils and four series coils which are assembled separately on the pole shoes. The alternator series coils are connected in series with the

* Safety Car Heating and Lighting Company.

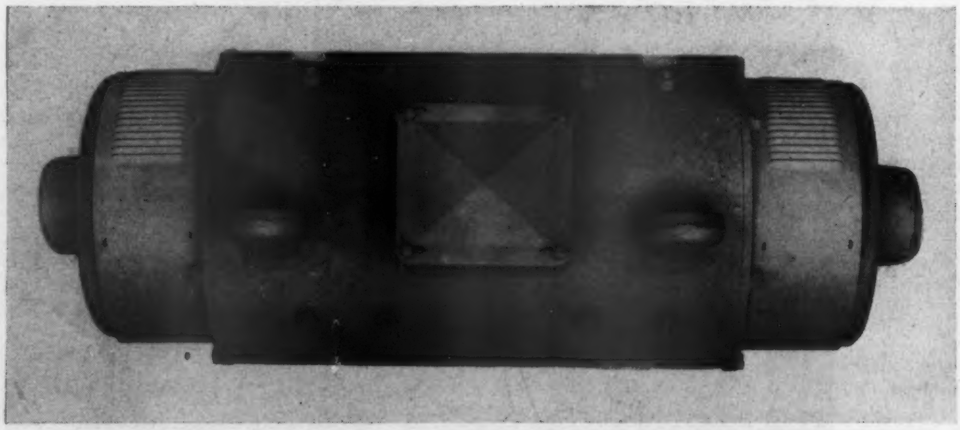


Fig. 1—The motor-alternator is 43 1/16 in. long, 15 in. in diameter and weighs 956 lb.

d.c. armature and compensate for voltage drop by increasing the field excitation. Their use improved the design by relieving the shunt field circuit including the regulator carbon pile of part of its load. Regulation for a wider range of input voltages, loads and temperatures is possible. The efficiency is improved slightly. But, above all, they help maintain a high a.c. voltage on sudden application of load, because their action is practically instantaneous.

The machine weights 956 lb., its magnet frame is 15 in. in diameter and 24$\frac{7}{16}$ in. long. The overall length is 43$\frac{1}{8}$ in. The speed is 1,800 r.p.m, and because of the sealed bearings no lubrication is required.

The step starter shown in the diagram is the Safety standard type used with the smaller inherently regulated machines. It weighs 17 lb.

The voltage regulator is a Safety type SC a.c. regulator, consisting of a carbon pile in the alternator field circuit and a resistor, rectifier and carbon pile operating coil in series across the a.c. output. The coil is across the d.c. terminals of the rectifier. The voltage regulator weighs 28 lb.

The frequency regulator consists of a carbon pile in the motor field circuit and a resistor, a frequency sensitive circuit, a rectifier and a coil in series across the a.c. output. The coil is across the d.c. terminals of the rectifier. The frequency sensitive circuit is made up of two units. The first has the double function of a reactor and a transformer. The second is a 3-terminal two section capacitor of which one section is in parallel with the reactor. The other section is in parallel with the rectifier and the mid-tap of the resistor in series. The frequency regulator weighs 38 lb.

Voltage Regulation

A small change in a.c. voltage causes a corresponding change in the operating coil current which varies the carbon pile resistance, thus maintaining the voltage substantially constant.

One important fact should be stressed. The a.c. circuit of the regulator acts as a pure resistance so that frequency variations do not affect its operation in the least. It acts independently of the frequency regulator.

It is possible to maintain closer regulation if the carbon pile is operated well within its resistance range, only the middle portion being used. The series field of the alternator allows such operation.

The increase in the resistance of the operating coil due to heating would normally cause regulation at a higher voltage because the current in it is substantially constant. Therefore, a compensating zero temperature coefficient resistor is placed in series with it and the rectifier, partly for the purpose of temperature compensation and partly to limit the voltage across the rectifier. The rectifier itself has a negative temperature coefficient and helps somewhat to compensate for temperature changes.

Obviously, if the resistance of the coil and the voltage across it are small in comparison with the resistance and voltage of the resistor, better compensation results. Furthermore, the greater the resistance, and voltage drop of the rectifier, the better the compensation.

In the present regulator, the resistance of the resistor was made approximately three times as large as that of the coil. Furthermore, the selenium rectifier was purposely selected larger than necessary. This results in safer operation because it eliminates

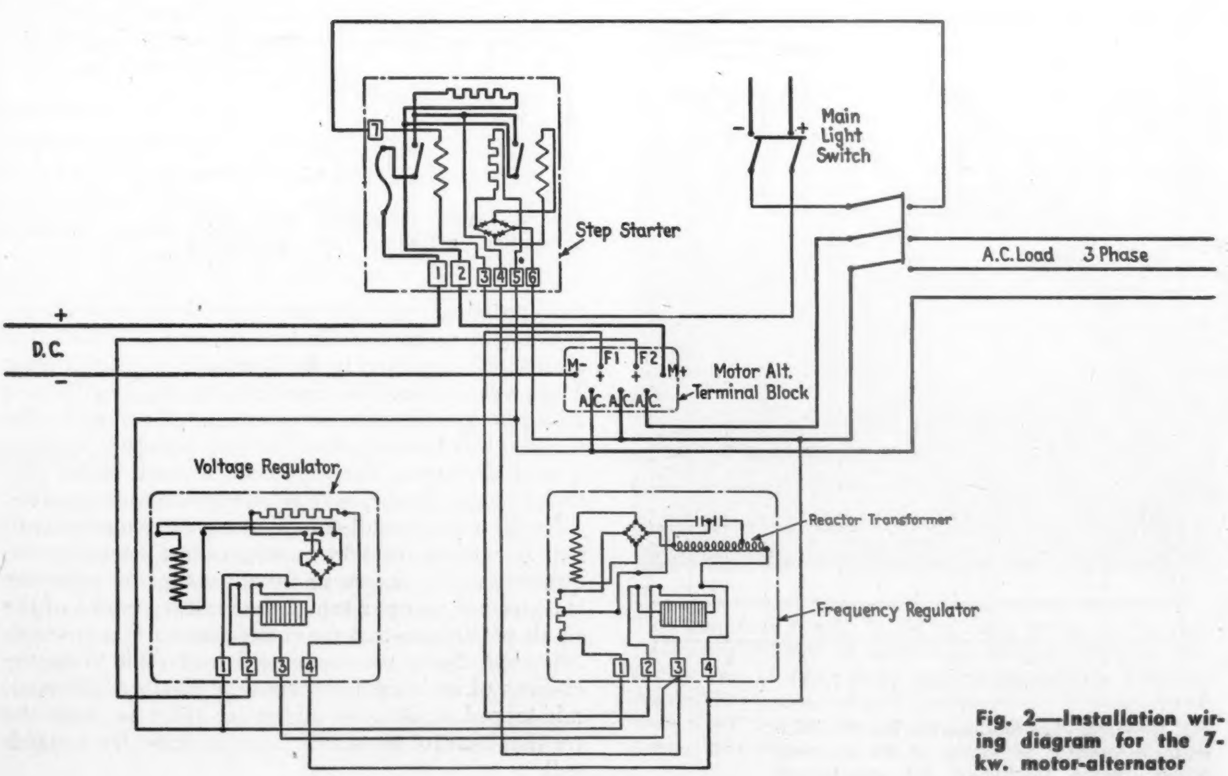


Fig. 2—Installation wiring diagram for the 7-kw. motor-alternator

the possibility of rectifier breakdown due to voltage surges. It also helps limit voltage variations caused by temperature changes.

The guaranteed maximum regulation is plus or minus 3 per cent. The average regulation of the machines which have been built is approximately plus or minus 1.5 per cent. This figure includes variations due to load, voltage and temperature changes.

The power losses in the a.c. control circuit including resistor, rectified and operating coil are 88 watts.

Frequency Regulation

The frequency regulator operates on the same principle as the voltage regulator except that the resistive circuit across the a.c. line is replaced with one which is essentially reactive, and which is approximately four times as sensitive to frequency variations as it is to voltage changes.

Theoretically, a regulator using such a circuit is not completely independent of voltage. A four per cent change in voltage results approximately in a one per cent change in frequency. But because of the close voltage regulation, the inertia of the motor alternator and the high damping of the dashpot, it acts, for all practical purposes, as a totally independent unit.

Because a shunt motor overspeeds and destroys itself, if the field is opened, the motion of the carbon pile is limited to a maximum resistance of 110 ohms by a stop.

Disregarding for the present various refinements, the a.c. circuit of the regulator consists of a reactor, or coil, and a 10.5 mf. capacitor in parallel, the parallel circuit being connected in series with the rectifier and the carbon pile operating coil. Because the currents in the reactor and the capacitor flow in opposite directions, the rectifier current is the difference of the two. This same current is rectified and passes through the regulator coil. For example, if the current through the reactor is 1.0 amp. and through the capacitor 0.70 amp., the difference, —0.30 amp. passes through the rectifier and the operating coil. The other 0.70 amp. circulates around the parallel circuit between the reactor and the capacitor.

At very low frequencies, the current in the reactor is very high because it varies in inverse proportion to the frequency and in the capacitor very low because it varies directly as the frequency. At high frequencies, the opposite is true. At 73 cycles, the two currents are substantially the same and the current in the coil and rectifier is insignificant. At this frequency, these are in parallel resonance.

At 60 cycles, the current in the reactor is approximately 1.0 amp., in the capacitor 0.70 amp., and in the operating coil 0.30 amp. At 57 cycles, the current in the reactor would be 1.05 amp., in the capacitor 0.665 amp. and in the regulator coil 0.385 amp. Thus, a 5 per cent decrease in frequency results in a 28.3 per cent increase in operating coil current. Obviously, this type of circuit is very sensitive, because a small frequency change causes a much larger current change. Hence, very close regulation is possible.

In the actual regulator, the above circuit is modified in several ways to meet practical operating requirements. As shown in the diagram, the capacitor is connected across a tap of the reactor instead of the whole winding so that the voltage across it is less than 200 volts. Since the capacitor is rated 230 volts, the chances of its breakdown are very small. A 200-ohm, mid-tapped resistor is added in order to limit the rectifier current on starting the machine from standstill.

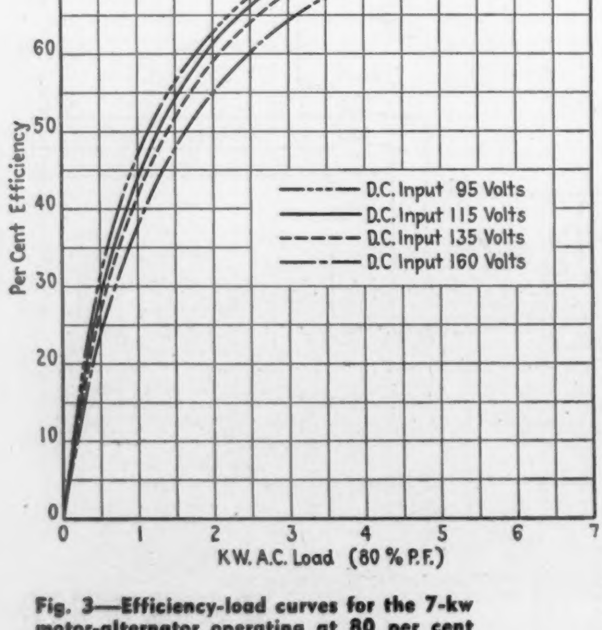


Fig. 3—Efficiency-load curves for the 7-kw motor-alternator operating at 80 per cent power factor (including all auxiliaries)

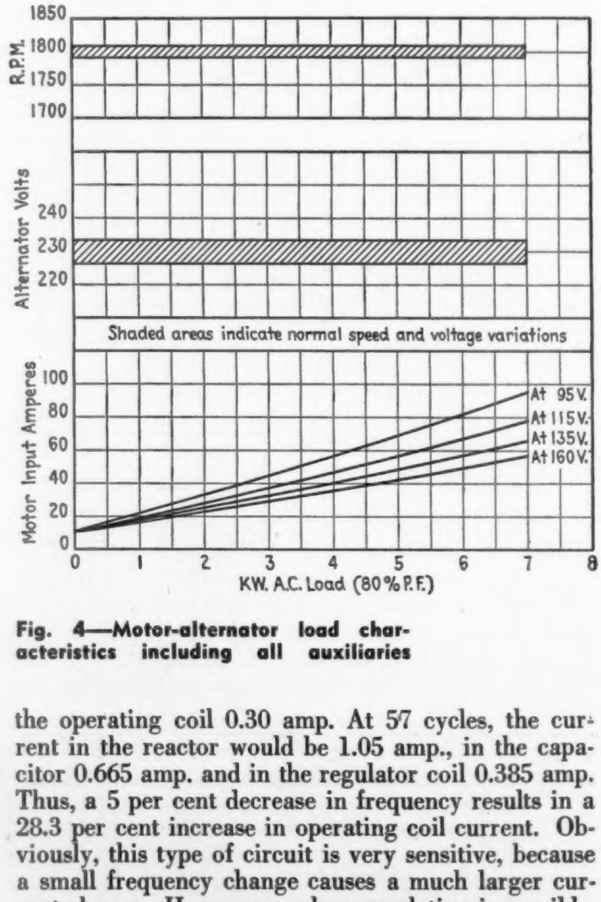


Fig. 4—Motor-alternator load characteristics including all auxiliaries

An auxiliary 4.5 mf. capacitor assembled in the same can as the 10.5 mf. unit is added. It is connected across the rectified and a 100-ohm tap of the resistor. It is placed in the circuit to increase the maximum allowable carbon pile resistance so that large variations in it caused by temperature changes and excessive vibration cannot under any circumstances raise that resistance beyond the operating limits of the regulator. This is equivalent to increasing the maximum operating frequency beyond which the regulator would function properly. The maximum carbon pile resistance is increased from 90 ohms to 130 ohms and the maximum frequency from 77 to 100 cycles. The operating range of the regulator is increased. The adjustment for maximum resistance is less critical.

The operation of the frequency regulator is practically independent of temperature. The voltage across the regulator coil is small, and 90 deg. out of phase with that of the parallel resonant circuit. Its positive temperature coefficient is partially compensated by the negative coefficient of the rectifier. Therefore, the change in its resistance due to temperature has very little effect on the current flowing into the circuit. The capacitor was especially selected to give a minimum variation in capacity with temperature. Laboratory tests did not show any variation in frequency during the heat run. It has been estimated, however, that if the ambient temperature of the regulator varied between minus 30 deg. C. and plus 50 deg. C., the total change in frequency would be 0.4 per cent. The specified maximum frequency regulation is plus or minus one per cent. In all the tests conducted on various machines, it held within plus or minus .5 per cent.

The power losses in the a.c. control circuit including the resonant unit, auxiliary capacitor, resistor, rectifier and coil are 68 watts.

The step starter consumes 49 watts. The total losses of all the auxiliaries, i.e., the step starter and the regulators, are 205 watts.

Heating

Both fixed losses, consisting of the mechanical shunt field, and iron, and the variable consisting of armature and series field copper losses, are comparatively small. Hence, the motor alternator runs cool and it is efficient throughout a wide range of loads.

In the heat runs conducted on the 115-volt unit, all parts of the Class B insulated armature had temperature rises well below 65 deg. C. The temperature rises of the Class A insulated field coils and other parts of the machine were well below 50 deg. C.

Efficiency

The specified minimum efficiency at rating, 7.0 kw. at 115 volts, is 76 per cent. This is the overall efficiency including the losses of all the auxiliaries. It is the ratio of output to total input multiplied by 100.

The efficiency will vary somewhat from one unit to another due to permissible manufacturing tolerances. The curves show the efficiencies at various loads and voltages determined by tests on the 115-volt machine. At 7.0 kw. and 115 volts, the value is 78 per cent, i.e., 2 per cent higher than the specified figure.

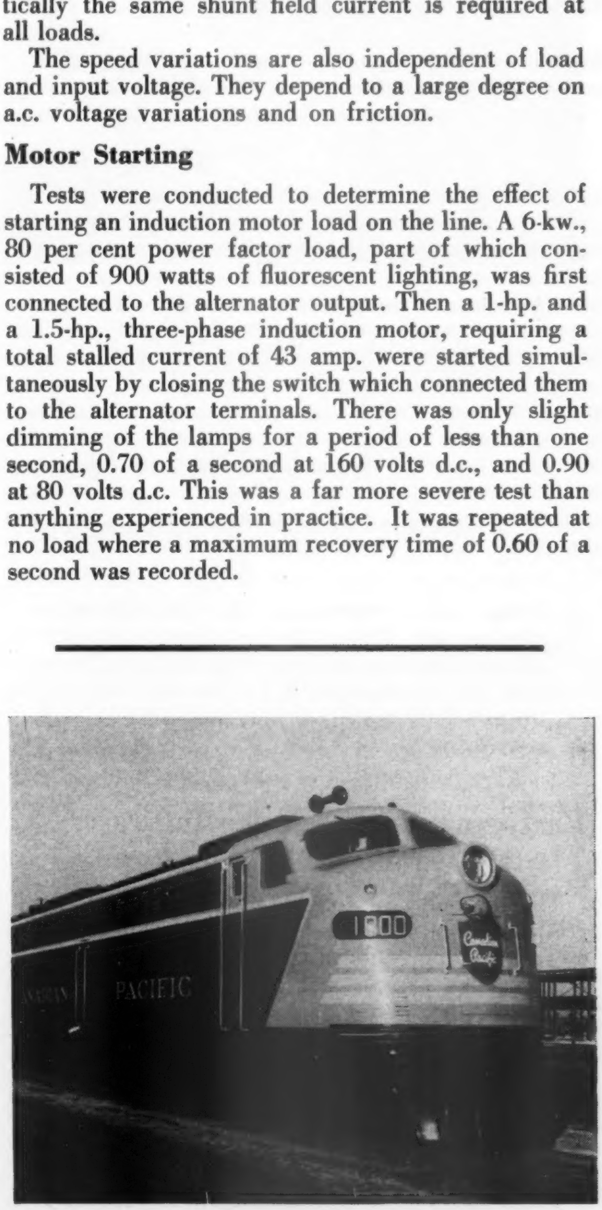
The 115-volt curve, (Fig. 3), shows an efficiency of 76 per cent at 5.0 kw., 74 per cent at 4.0 kw., 70 per cent at 3.0 kw., and 61.5 per cent at 2.0 kw. Obviously, the equipment may be operated at fairly light loads without incurring the usual penalties of excessive losses and very low efficiencies.

Figure 4 shows motor input current, alternator output voltage and motor speed plotted against load. The voltage and speed are shown plotted as two shaded areas. The voltage variations are practically independent of input voltage and load. They depend to a large degree on friction in the voltage regulator, and somewhat on the position of the plunger in the coil. Because of the alternator series field practically the same shunt field current is required at all loads.

The speed variations are also independent of load and input voltage. They depend to a large degree on a.c. voltage variations and on friction.

Motor Starting

Tests were conducted to determine the effect of starting an induction motor load on the line. A 6-kw., 80 per cent power factor load, part of which consisted of 900 watts of fluorescent lighting, was first connected to the alternator output. Then a 1-hp. and a 1.5-hp., three-phase induction motor, requiring a total stalled current of 43 amp. were started simultaneously by closing the switch which connected them to the alternator terminals. There was only slight dimming of the lamps for a period of less than one second, 0.70 of a second at 160 volts d.c., and 0.90 at 80 volts d.c. This was a far more severe test than anything experienced in practice. It was repeated at no load where a maximum recovery time of 0.60 of a second was recorded.



Canada's first streamlined Diesel passenger locomotive—This Canadian Pacific 2,250-hp. unit, made by the Electro-Motive Division of General Motors at LaGrange, Ill., is the first of three to be used to completely Dieselize the C.P.R.'s passenger and freight service between Montreal, Can. and Boston, Mass., in conjunction with the Boston and Maine

CONSULTING DEPARTMENT

An experienced operator can determine the condition of a seasoned commutator with the aid of a carbon brush—In this case the commutator is heated by means of friction brushes

Can you answer the following question? Answers should be addressed: Electrical Editor, Railway Mechanical Engineer, 30 Church Street, New York 7.

Does changing the gear-ratio or wheel diameter have any effect on the speed-tractive-force curve of a Diesel-electric locomotive?

On certain of our cars, we have frequent trouble with the mercury tube thermostats; whereas on other cars of an identical design we have practically no trouble with the same kind of thermostats. Can anyone suggest why we have a lot of trouble on some cars, and no trouble on similar cars?

Should Diesel Motor Commutators Be Seasoned?

What can seasoning do for traction motors on Diesel-electric locomotives? Should the commutators of rewound motors be seasoned? What is the recommended procedure for the process of seasoning?

Performance in Service Indicates The Desirability of Seasoning

The seasoning of commutators in high-speed operation has been standard practice for many years on railroads operating a.c. single-phase commutating motors. This practice has been responsible for the elimination of a good percentage of flashovers resulting in reduced power, train delays and armature removal and repair.

Its application to high peripheral speed motors in Diesel-electric locomotives is justified when the service causes commutators to lose their concentricity resulting in heavy commutator maintenance.

The deterioration of commutators is gradual as a result of continual expansion and contraction of the commutator bars. Periodical seasoning appreciably lengthens the period between armature overhaul, extends commutator life, reduces flashovers, considerably aids commutation, increases brush life and reduces the load on the armature shop and the labor involved.

Seasoning procedure consists of grinding of the commutator to concentricity, rotating the armature at the recommended speed while heat is applied by means of a gas flame. The commutator is tightened, heated, cooled and the cycle repeated until concentricity is attained within close limits both hot and cold.

With this method established at the plants of the electrical manufacturers, new commutators are well seasoned to withstand expected temperatures in service. Repetition of the seasoning at the shops of the railroads has been found very desirable.

W. F. Fauerbach
Morganite, Incorporated

Commutators Need Not Be Reseasoned Unless Disturbed

Seasoning of traction motor commutators whether for Diesel-electric locomotives or other railway equipment leads to more stable conditions of commutation and brush life than can be experienced with a green commutator. Properly seasoned, a commutator will not be subject to loosening of assembly bolts, bar shifting or bar distortion. All of which means a uniform commutating surface that will permit good commutation and brush life with the proper brushes.

After a period of service in its normal application, any commutator will be seasoned whether put in service green or not. If properly maintained when first put in service, a green commutator will stabilize, and be seasoned and can be expected to perform as a pre-service seasoned one. However, that requires a lot of work, and that means high maintenance costs.

Should the Commutators of rewound motors be seasoned?

Fundamentally, seasoning consists of spinning a commutator under high temperatures and tightening up its assembly bolts at carefully predetermined intervals. It does not appear desirable to suggest that users of traction motors equip themselves to build commutators. With that in mind, the logical process would be to procure properly seasoned commutators from the original manufacturer of the motor involved. Thereby, the operating railroad would avoid chances of splitting or warping armature segments, overstressing bolts, or damaging insulating cones on "V" rings. Also, the user would be taking advantage of the accumulated experience of the manufacturers of large numbers and types of electrical motors.

S. GUY FORBES
General Electric Company

Have Mercy on the Motor

About 25 years ago when a successful electric transmission was first introduced to railroad service in the gas-electric age, the speed was slow in comparison to present day speed, and commutators and commutation was not a serious problem, but as speed increased and power plants became larger, traction motors had to keep pace with this increase of horsepower. Because of space limitations, this had to be done with practically the same motor except that equalizers were applied and forced air cooling was introduced. As motors became still larger, the only addition was increased volume of air. During this time more and more brush trouble developed, with the result that pressure was brought to bear on brush manufacturers to develop a more stable brush.

Over a period of years, the brush manufacturers did develop a better product. Formerly, when a set of brushes was applied to a motor, one or two brushes in a set would wear down considerably faster than the balance of the set and every once in a while one brush would cut the commutator. Brush wear was so uncertain that it was common practice to change only one or two brushes at a time, as no one could predict what a brush would do. This was quite a problem as commutator wear was considerable, and grooving and roughening of commutator was serious. Several bars in a commutator would show signs of discoloration, etc.

Brush manufacturers were blaming the motor manufacturer for loose commutator bars, soft copper, etc., with the result that better copper was produced, mica with less binder was developed and commutator design was improved.

During this period of many years, one of the newer manufacturers of traction motors developed an overspeed method of tightening commutators. The commutator was run at about 50 per cent overspeed so that centrifugal force developed would throw the individual commutator segments out against the vee ring. This machine had a variable speed control and after each increase in speed, the machine would be stopped, and the commutator would be tightened. Later on, heat was added to the process to speed up the completed job. First, heat was applied by friction and later on by an outside source, and this is what was known as commutator seasoning. This process became a bottle neck because of the time required, and some other method was desirable.

It was common practice during this period of development to finish the copper segments to size and then assemble them on a mica vee ring aligning them as the commutator built up. Commutator bars that did not align to certain limits were used on low speed switch engines, and the balance on passenger engines, but as the demand for commutators became greater, some other means of manufacture had to be developed.

This was a healthy condition and was responsible for a lot of improvement in both commutator and brush development, and is really what causes all, or a very large part of our engineering improvement in all branches of engineering. Consequently, today commutator bars are first rough punched, then assembled with mica segments, vees are machined in, after which a shell is inserted, and the commutator rough machined on its outside diameter. After it has been put through several bakings, and closing operations, it is given a final machining, final bake and closing. Then slots are milled and, after a final grinding, the commutator is ready for application to a motor.

With all these improvements, we still have a few commutators that will break brushes, but after removal, nothing can be found wrong with the commutator. This same commutator without anything being done to it, will be put back in service, and will give good performance. This is caused by vibration set up in the motor that actually causes the commutator to become eccentric and break brushes.

A considerable amount of money and time is spent on dynamic balancing of armatures. This has considerable merit, and should be continued, but a very large per cent of our motor trouble, both winding and commutator, is caused by vibration set up by the method in which motors are suspended in the truck.

We purchase a small desk fan, and pay perhaps $25.00 for it, and we expect to be able to set this fan on our desk or drawing table without having any trouble from vibration. We do not have any because it will be perfectly balanced, and set in rubber at several points, to absorb what little vibration there might be. On the other hand, we will spend from $5,000.00 to $6,500.00 for a traction motor, and mount it directly on the axle, without any means of absorbing shock, with the result that the terrific pounding caused by out-of-balance of axles and wheels, rail joints, bad meshing of gears, loose trucks, etc., is all transmitted to the motor and finally the armature commutator and windings,—and this pounding can be measured in tons. The designer of the locomotive has taken many precautions to see that this pounding is not transmitted to the power

plant which is protected by springs, rubber mountings, shock absorbers, etc., but the motor has not had any of the safeguards taken, with the result that traction motor maintenance is very high.

We seem to have about seven sources, or periods, of vibration in the motor,—one in the overall motor frame, one at the commutator, one between commutator and laminations, three in the laminations themselves, and one outside the laminations on the pinion end.

This vibration is a large contributing factor in commutator trouble. The split brush has gone a long way to help correct this trouble. This vibration is the reason why the commutator will break brushes when mounted in one motor, and work perfectly in another. This vibration is unpredictable and will vary in position in the truck, because of loading, wheel condition, etc.

There is a considerable amount of engineering required on motor suspension, and if railroads will either undertake to correct the condition themselves, or insist on manufacturers doing it, a large amount of money could be saved, and considerable improvement in service and availability could be shown, and about 95 per cent of our commutator and traction motor trouble be eliminated.

C. F. STEINBRINK
Chicago, Rock Island & Pacific Railway

The When, the Why and the How of Commutator Seasoning

To answer the above three questions intelligently, a brief description of fundamental commutator construction may not be out of place.

Any railway generator or motor commutator is made of a set of copper bars and mica insulating segments. In each end of the set there is machined a vee-shaped groove. Into each of these vee-grooves a mica-vee-ring is fitted. Steel rings with a corresponding vee-shape fit into the mica vee-rings. When assembled, the pressure applied to the steel vee-rings is transmitted through the mica vee-rings to the copper bar and mica strip assembly. The machining of the steel parts bears such a relation to that of the copper bar and mica strip assembly that the major part of the applied pressure tends to pull the copper bars and mica strips into a smaller diameter. This forces the copper bars and mica strips tight against each other, a condition referred to as "arch-binding." The remainder of the applied pressure is used in applying a rather light force near the end of the copper overhang. This makes firm contact against the mica vee-ring and seals out dirt and moisture.

A complete commutator is really a combination of springs, the most elastic member being the mica strips between the copper bars. Any change in conditions, such as speed or temperature, is reflected as a change in distribution and magnitude of the various forces inside the commutator.

The successful operation of commutators, in general, depends upon the relation between the different parts. A movement of just a few copper bars with respect to the other bars leads to roughness, sparking, and rapid wear. To prevent any such movement, the commutator must be kept tight enough that the relative motion of any part is held to a minimum.

The process of seasoning requires pressing and a torque wrench for tensioning of armature bolts

The problems that arise in maintaining railway type commutators are similar to those that arise with other types of commutators, although there are some differences in details. It is well to consider what these differences are, and how they relate to commutator performance, to have a better understanding of the maintenance requirements.

The first consideration is the operating temperature. All commutators are affected by changes in temperature, since their steel, copper, and mica parts all expand at different rates. These differences in expansion rates cause higher internal stresses with higher temperatures. Since railway machines are necessarily operated at higher maximum temperature than industrial machines, the extra expansion must be taken into account when their commutators are designed.

There are three principal design types of commutators: the ring nut, the bolted, and the disc spring. For taking care of the longitudinal expansion, the ring nut type is least effective; the bolted type is better; while the disc spring type can handle the most expansion. This is why the disc spring type commutator is used in some of the larger high-speed traction motors.

Having mentioned the three design types, it seems necessary to describe them briefly. First, comes the simplest of the three; the ring nut type. In this type of commutator, the ring nut has internal threads that engage the threads of the commutator spider (sometimes called the shell or bushing). When the ring nut is tightened, it applies force to the steel vee-ring which in turn holds the copper assembly tight.

The second type of commutator is the bolted one,

—probably the best known and the most widely used of the three. In this type a number of long bolts are screwed into tapped holes in the commutator spider so that their heads apply force to the steel vee-ring to hold the commutator tight. Sometimes, long studs are used instead of bolts, but the principle is still the same. The bolted commutator derives its capacity to take care of expansion from the fact that the bolts themselves can stretch lengthwise to a certain extent and still not yield; in other words, they can still be within their elastic limit and shorten up again when the other commutator parts contract.

The third type is the disc spring, which was mentioned as being able to handle the most expansion of the three. It resembles the ring nut type, but differs in this important way; the force of the nut is not applied directly to the steel vee-ring but to the disc spring, which in turn applies the force to the steel vee-ring. This disc spring is made of high grade alloy steel and can be deflected to a high stress without yielding. One of the advantages of the spring type commutator, not held by either of the other types, is that the internal pressure of the commutator can be determined at any time simply by measuring the deflection of the spring, using a dial gauge. The springs are calibrated before assembly, thereby giving a basis for converting dial gauge readings into equivalent pressure directly. The maintenance of these commutators is somewhat more specialized than the other types. They are successfully serviced by shops that have the correct factory-built tools and gauges, but should not be repaired by other shops.

What Does Seasoning Do for Commutators?

The mica vee-rings and the insulating mica segments between bars are usually made up of mica flakes bonded together with shellac. When new commutators are being processed at the factory they are seasoned by being repeatedly baked and tightened for the purpose of driving out the excess shellac at the principal zones of pressure. In the case of certain high-speed railway motors, the final seasoning at the factory is done with the commutator rotating at full speed in a suitable oven. This rotational seasoning is more effective than stationary seasoning because it allows the stresses due to centrifugal force to be applied simultaneously with the stresses due to thermal expansion. When a well-seasoned commutator leaves the factory it can be expected to give satisfactory service until disturbed by some unusual condition, or until normal aging over a long period of time gradually causes roughness.

Should the Commutators of Rewound Motors Be Seasoned?

Every commutator that has seen long service eventually requires some attention. The nature of the work to be done depends on many things and each case must be diagnosed individually, the decision being based on the previous record of the commutator in question as well as on its appearance. For example, consider a commutator that has received no unfavorable reports in operation but has some obvious surface condition such as high mica (or nearly so), burnt bars, marks from previous flashing, or eccentricity. Such a commutator may not require seasoning but its surface can be reconditioned by the following standard operations:—(1) grind or turn the copper surface in a lathe, removing as little copper as possible; (2) undercut the mica; (3) sandpaper (or grind) to remove the burrs; (4) clean the bar edges to remove all mica slivers; (5) blow the dust out with compressed air; (6) reassemble for service.

The foregoing set of operations is sufficient only for surface conditions. Now, take another example. Suppose there is a commutator with no apparent surface trouble but there have been reports of short brush life. This is an indication that some roughness develops when the commutator is hot and running at high speed. Therefore, this commutator may be loose and should be seasoned.

Still another example of a possible loose commutator would be one that has been turned or ground several times and seems to have a relatively short period before it requires attention again. In such cases, while other sources of commutation trouble should be looked for in the machine, it is wise to assume that the commutator is loose and requires seasoning.

When an armature is to be rewound, the commutator should be seasoned in order to have it in the best condition to match the new coils that will be put in. If a commutator is already worn down nearly to the condemning limit, it should not be used with a complete new armature winding, since it is not economically sound to take the risk that the commutator will soon be worn to the allowable limit and force the scrapping of the armature winding. When it is decided that the use of the old commutator is justified by its remaining wearing depth, the most convenient time to proceed with the seasoning is after the old armature coils have been stripped from the core.

What Is the Recommended Procedure for the Process of Seasoning?

First, mark the location of the ring nut with respect to the spider. A chisel mark is good. In the case of a bolted commutator, mark each bolt head.

Then, heat the commutator in an oven for about 4 hours. In the case of an armature from which the coils have been removed, a temperature of 140 deg.-150 deg. is the best for Class B insulation. If a higher class of insulation is used, the temperature at which the commutator is baked should be increased to the rating of the insulation. When a commutator is connected to good armature coils, the temperature to which it can be raised is limited by the temperature the winding insulation can stand.

When the commutator is removed from the oven, and is still hot, tighten the ring nut, or the bolts, while under a press. This requires a tool which can usually be made in a good repair shop. It enables the required pressure to be applied to the steel vee-ring while still leaving access to the commutator nut or bolts for tightening. The total force to be applied by the press depends upon the size and design

Grinding commutators with armatures on own bearings

of the particular commutator in question. It is best to get the recommendation of the manufacturer and follow it.

After pressing and tightening hot, allow the commutator to cool and repeat the tightening with the same press tonnage as when it was hot.

Observe the location mark that was put on before the tightening operation was started. If the movement has been less than 1/4 in., the commutator is tight. If more than 1/4 in., repeat the whole heating, pressing, cooling and pressing sequence. In some cases, it may even be necessary to repeat the whole sequence another time. If this seems to be an involved process, just remember that it is usually the only real salvation of an old commutator.

After the tightening is completed and the other armature work is done, the usual undercutting turning or grinding can be done.

In the case of a commutator that has been repaired by applying new mica vee-rings, the same sequence of heating and pressing is recommended. This seasons the new mica vee-rings by baking the shellac that is in the mica.

After any armature is completely rewound, whether with a repaired commutator or a brand new commutator, it is good practice to give it one more cycle of heating and pressing, for the reason that the excessive heat developed when soldering the armature coils to the commutator necks may further disturb the commutator.

The foregoing set of instructions applies to the method of stationary seasoning, which is all that can be accomplished in most repair shops. For those well-equipped shops that have facilities for rotational seasoning, the method is somewhat different. Each of the four-hour heating cycles, after the first one, takes place in the rotational seasoning oven instead of a stationary oven. The commutator is rotated at approximately its maximum operating speed during these heating cycles. At the end of each heating cycle, the condition of the commutator can be observed. A convenient way to do this is to move an ordinary carbon brush, held firmly but not too tightly in the hand, along the surface of the commutator while it is spinning, both hot and cold. After some practice at this, one is able to distinguish the roughness caused by eccentric or oval surfaces, from the roughness caused by looseness, and high bars. The former cases are helped by regrinding, while the latter require retightening and additional seasoning cycles. When a commutator stays smooth, both hot and cold, through a seasoning cycle, or if the observed roughness when hot is very slight, the seasoning can be considered as completed and the machine re-assembled for service.

R. E. KELLY
Westinghouse Electric Corp.

Heating Cable Prevents Freezing of Water Pipes

Twelve years of service has proven the usefulness of electric heating cable in the Cleveland Union Terminal and has substantially reduced the expense of maintenance during freezing weather. The cable, supplied by the General Electric Company, was installed 12 years ago on 88 water service laterals in the terminal, coach yard, and station. Prior to 1937, considerable trouble was experienced with the water laterals in the wintertime. Freezing and bursting pipes were a routine maintenance problem, and station and coach yard platforms had to be dug up frequently to repair the damaged pipes.

In 1936, the terminal began its program of installing the heating cables on these laterals. The cable used was No. 19 Nichrome resistance wire, insulated with asbestos, varnished cambric, and covered with a lead sheath. Each circuit consisted of 60 ft. of heating cable connected to a 110-volt direct current circuit.

Engineers divided the 60-ft. circuit into 12 to 15-ft. units, and each unit was coiled around the water lateral pipe to be protected. The intermediate connections between the heating units were made through buried, non-metallic, trench-type cable. The temperature of this heating cable in open air, when connected to the proper voltage, is about 165 deg. F.

Pipe laterals were made accessible for the cable installation and maintenance by constructing small brick chambers with removable metal covers.

Recently, the Cleveland Terminal made additional use of G. E. heating cable. Compressed air is supplied to station and coach yard tracks from a central air compressor plant. At this plant, an outdoor type, air-cooled after-cooler is used to remove moisture from the compressed air. During freezing weather trouble was experienced draining off trapped moisture. Sixty feet of heating cable was wrapped around the drain pipes and traps which were then covered with waterproof insulation.

By applying heat to the pipes and traps during sub-freezing weather, the terminal engineers are able to guarantee trouble-free operation of the after-cooler at all times.

EDITORIALS

Electrical Associations

Some vigorous action seems to be indicated for the railroad electrical associations. The two A.A.R. Electrical Sections, for example, have lost leadership at the time when the need for such associations is greater than it has ever been before and is increasing rapidly. J. A. Andreucetti, secretary of the Electrical Section, Mechanical Division, was retired after the 1949 Fall meeting and W. S. Lacher, secretary of the Electrical Section, Engineering Division, will retire in April of this year. It may be said that the elected officers run the associations, but if any such organization is to be a success, the secretary must be both "wheel horse" and "spark plug." He must carry the burden of the paper work. He must also be able to see what is needed of the association and by "needling" or some other more effective means of persuasion, get the members and elected officers to do that work.

The immediate job of the association is two-fold. They must in effect go two ways at the same time. What is usually looked upon as a first requirement is the necessary legislative work which must be carried on within the framework of the A.A.R. and the preparation of standards and recommended practices.

A more immediate and more urgent need is that of providing education to the new men in the field and of providing answers to current problems. A considerable number of the men who must operate and maintain Diesel-electric locomotives are mechanical men who must understand electrical devices if they are to perform their work effectively. Complicating this situation are the ever-changing problems which arise from the use of apparatus which is undergoing development.

One of the ways this need is being met may be seen in the growing number of Diesel railway clubs which are being formed in various parts of the country. Another is being accomplished through meetings held by small groups of manufacturers and railroad men in various parts of the country to discuss current problems common to air conditioning, car lighting, car heating and car power supply. In the latter case, much important information is developed, but there are no minutes of the meeting. The Diesel clubs publish papers, with their discussions, and the car groups may adopt this practice.

The hazard to the A.A.R. Sections is that these other groups may render Section work relatively unimportant. Already disparaging remarks are heard at the small car men's meetings concerning the inadequacy of the formal associations.

Several things could and perhaps will be done to correct the present deficiency. If the two sections were combined, both duplications of membership and work done could be avoided. Given a full-time secretary of adequate ability and knowledge of the field, the Section could become a live and dominant force which would exercise real leadership. Given this position and prestige, it could look forward to eventually becoming a part of an electrical division. Electrical applications are completely diverse. They are included in every phase of railroading. If they are separated into pieces which serve individual railroad departments, the great value of standardization which can only be established satisfactorily by a single organization will be lost.

Perhaps this last suggestion is looking too far into the future, but it may at least serve to indicate a direction. The present need is to supply immediate and pressing demands; to give the associations a vitality which will assure them the leadership which is essential to railroad requirements and which cannot be accomplished effectively by a number of smaller organizations.

Car Department Problems in 1950

As railroads face into the new year, all branches of mechanical departments face difficult problems, but none more acute than the car department. Questions of car supply, both passenger and freight, to meet traffic demands are of course uppermost, but second only to servicing, inspection, maintenance and personnel training.

Many mechanical details must receive expert attention. A recent survey of opinion regarding freight-car matters emphasized the need for still further intensive efforts to strengthen car floors, eliminate as soon as possible wood running boards and install more rapidly the latest pipe anchorage devices. Brake-beam tension rods with threaded ends were also listed as objectionable.

The perennial problem of better lubrication materials and practices to minimize hot boxes was repeatedly stressed, also the need for modern trucks and more effectively maintained cars in all details to operate satisfactorily at ever-increasing speeds.

The excessive cost of up-grading cars for higher-class commodity loading was listed as a major deterrent to making badly needed improvements in car condition. An appeal was registered for improved packaging to reduce lading damage, more prompt return of freight cars to home lines and the replacement of old equipment with modern cars built of low-alloy high-tensile steel, or other lightweight materials.

In answer to the specific question if an upward-graduated per diem rate would encourage the application of lightweight cars, roller bearings, load-compensating brakes, improved trucks, etc., railway car officers showed a most decided difference of opinion and split almost 50-50 between "Yes" and "No." Some who answered in the negative said this would place an unfair burden on short line terminating carriers which will not benefit much, if at all, from the improvements. Others gave the idea full approval. Still others qualified their answers by saying that a graduated per diem on the basis of modernized cars would be impracticable, but might prove useful if based on car classification for higher commodity loading.

Judging from this limited survey, it seems apparent that considerable misinformation and misapprehension exists regarding the merits of graduated per diem rates based on mechanical conditions and should be cleared up to make sure railroads are not missing an opportunity to stimulate more rapid application of recognized freight-car improvements.

Some significant figures have just been made available regarding the overall picture of freight-car supply and efficiency of use in 1949. The number of new cars installed was about 10 per cent less than the preceding year; retirements were cut 24 per cent; cars undergoing or awaiting repairs increased to 7.3 per cent of the total number on line; all cars advanced in age, almost 35 per cent of them passing the quarter century mark.

The steady decline in general condition of freight cars with respect to serviceability was indicated by the increased amount of equipment in bad order. Railroad and private cars undergoing or awaiting repairs increased rapidly in number and percentage-wise every month in 1949, comprising 4.5 per cent of the total cars on line in January and 7.3 per cent in November.

Box-car turn around in October (13.94 days) was the best of the year. But the average was adversely affected by abnormally high turn-around time for gondola and hopper cars (23.63 days and 36.89 days), idled by the coal and steel strikes. A contributing cause for the reduced efficiency in use of cars of all types was the five-day week, effective September 1, which necessitated granting Saturdays as free days for demurrage purposes and thus tended to increase delays in unloading.

Several large orders of new freight cars for delivery in 1950 have already been placed. This bears out the prediction of J. T. Faricy, president of the Association of American Railroads, late in 1949, that individual railroads will soon begin placing orders for freight cars, not because business is good, but because the cars are wearing out.

He also pointed out that more freight cars are required to handle a given volume of traffic under the new five-day railroad week and cars are generally being loaded less heavily than during war years, both conditions reducing the efficiency of car use and hence necessitating the provision of additional equipment. In view of the many uncertainties, any forecast of freight-car orders in 1950 is obviously a guess, but substantial numbers will have to be ordered and actually installed, or little real progress will be made in meeting and correcting the conditions mentioned by President Faricy.

Why Not Do the Job the Best Way

When two or more ways exist to do a given job, and one of the ways has been proved markedly superior to the others, it is difficult to understand why the way that has been proved best is not used by the majority of people doing the work to which the best method is applicable. Applying this puzzle to a specific case, why do the majority of roads persist in laying out locomotives by any means other than a transit?

The experience of the Chicago & North Western with the transit method of layout* should be proof enough to anyone that the method has distinct advantages over conventional ways of doing the same job. That road's 20-year-old Class H 4-8-4's averaged 25,991 miles between Lidgerwooding when laid out by ordinary procedures. When the transit method was substituted on two of the H's, but no other change made, this mileage increased to 34,144, an increase of one-third. On locomotives of this class which were both modernized and laid out with a transit, the original mileage was more than doubled to 52,203. Individual locomotives of this class have exceeded 100,000 miles between Lidgerwooding.

In all the above averages intervals were eliminated where the primary reason for the Lidgerwooding was flat spots or was unknown; the interval between the final Lidgerwooding and renewal of the tire was also eliminated. In this way the intervals between Lidgerwooding become a fairly accurate measure of how well the locomotive is aligned. For example, intervals terminated by flat spots were not included because these are caused by sliding the wheels during braking and are not affected by how well the frame is aligned.

Not only do the figures prove the worth of the transit method, but logical analysis of what the method accomplishes in the way of accuracy will do the same thing. The frame, shoes and wedges, guides and rods, and engine and trailer trucks are laid out absolutely correctly within a few thousandths—not to within the nearest readable mark on a scale, and without the error introduced in affixing straightedges. All major parts of the machinery are correctly aligned with respect to all other parts. The running gear moves in a plane absolutely parallel to the center line of the locomotive, and the axles

* The method and its results were described in detail in the *Railway Mechanical Engineer*, December 1949, pages 713-718.

are at 90 degrees, and not at approximately 90 degrees, to the center line.

The transit method alone is not, of course, the only reason that the North Western has attained such phenomenal parts mileages from its modernized 4-8-4's, but it is certainly a principal factor in attaining the records made by these locomotives. Without it, it is doubtful if such heavy power could be maintained for less than 20 cents per mile, have 90 per cent availability, and go 400,000 miles between Class 3 repairs, with no Class 5's given between 3's.

Future Mechanical Officers

At the recent annual meeting of the American Society of Mechanical Engineers a session was held under the joint sponsorship of the Railroad and Management Divisions, the theme of which was attracting mechanical engineering graduates to the railroad industry. F. K. Mitchell, manager of equipment, New York Central System, discussed the problems encountered by the New York Central System in attracting, training, and retaining engineering graduates in the mechanical department of that system, and described the methods now in use and results obtained. Mr. Mitchell's instructive paper is presented elsewhere in this issue.

Another paper on the program—a report on a survey of opinion from a large number of educators interested in relations between the railroads and the colleges by L. W. Wallace, counselor on management, Cincinnati, Ohio, and well known as an engineer interested in railway mechanical affairs for many years —and the discussions from the floor point to a status in the relations between the railroads and the colleges highly uncomplimentary to the railroads. The problem presented is one which should receive the earnest attention of railway managements—not just the leaders of mechanical departments, but top railway managements. The relations with engineering colleges should be but a part of a broad policy of recruiting and retaining college-trained men for service throughout railway organizations. As one professor of transportation said in the discussion, "I cannot emphasize too strongly the desirability of broadening the training of executive talent on railroads—especially engineers. The major problems of railroads today are to be found in the fields of public relations, finance and traffic."

Confining the immediate consideration to the mechanical department, however, the weight of the evidence suggests that the railroads generally are not greatly interested in securing talent of the first quality among the men whom they recruit from the colleges. Their attitude seems to relegate the problem to a sort of afterthought basis, with a willingness to take whatever material is left over after the electrical, chemical and other big industries have skimmed off all the cream.

Obviously, the induction of men from college should not exclude promotions from the ranks of shop men, but these men must disclose talent much broader than mere man-handling ability, the one quality which seemed all sufficient in mechanical-department officers and supervisors of a generation or so ago. Without departmental officers of strong character and keen minds, broadened by education, the quality of departmental performance will be no better than that which might be furnished by union-labor management, which is at the end of the present road.

The first step in remedying the present unsatisfactory relations between colleges and the railroads is the development of an adequate sense of responsibility on the part of managements generally for the future health of the industry after the present generation of officers has passed on. This will support the efforts of departmental officers to develop adequate recruiting methods. It will require a willingness to compete with other industries in the effort to interest the best product of the colleges in railroading as a career. Adequate competition will include all the questions of opportunity, including salaries and future prospects, which young men ready to choose a career must take into consideration.

A continued willingness on the part of any railroad to accept second- or third-rate prospects when recruiting men for its future officers will leave it in second or third position in its own competition for business against the other transportation agencies.

NEW BOOKS

ELECTRICAL ENGINEERS' HANDBOOK (ELECTRIC POWER). *Prepared by a staff of specialists. Harold Pender, Ph.D., Sc.D., and William A. Del Mar, A.C.G.I., editors. Published by John Wiley & Sons, Inc., 440 Fourth avenue, New York 16. 1,700 pages; 5½ in. by 8½ in. Price $8.50.*

The handbook is now issued in two volumes, one devoted to electric power and the other to electrical communication and electronics. Seventy-one specialists have contributed to this entirely rewritten electric power volume, as compared with twenty-seven, forty-five and fifty to successive previous editions. This reflects the increased importance which several subjects have assumed. Concerning fundamentals, the book deals with mathematics, properties of materials, electric circuits, principles of electro-chemistry, etc. Some of the subjects covered which deal with practice are batteries, d.c. and a.c. rotating machinery, rectifiers and inverters, switchgear, power stations and substations, power transmission and distribution, lighting and heating, servomechanisms, transportation, electrochemical and electrothermal processes, and rural electrification distribution systems.

CAR INSPECTION AND REPAIR

An Ice Plant on Wheels

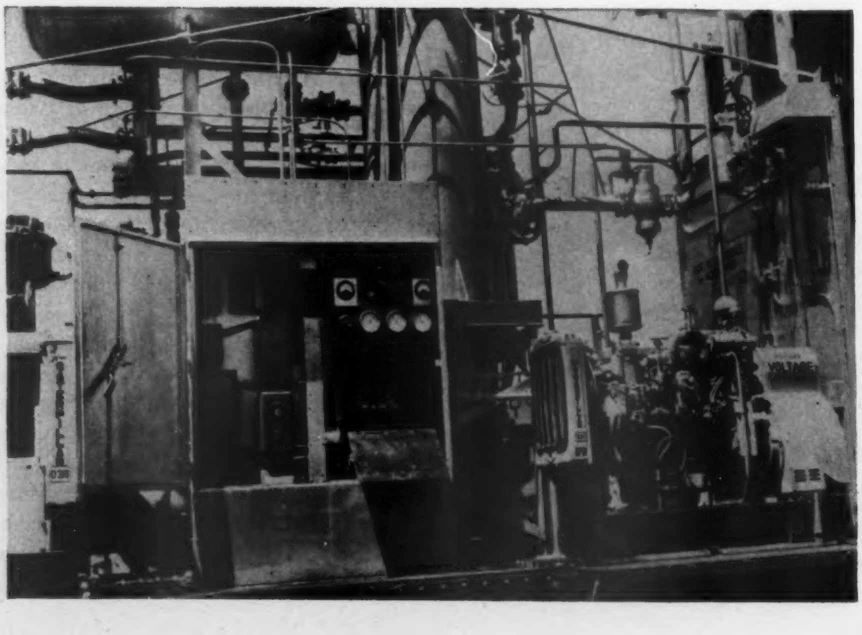
One of the most unusual peces of equipment used in connection with the shipment of perishables has recently made its appearance on the Kansas City Southern at Neosho, Mo. An ice plant on wheels, designed and built by the Haas Ice and Cold Storage Company of Neosho, is intended for icing refrigerator cars in transit, being mounted on a flatcar and capable of movement along a railroad for use at any desired spot.

Two Caterpillar Diesel engines supply power for the portable ice plant. A D 318 engine powers the refrigeration unit, and a D 311 electric set furnishes power for lights, motor for the two conveyors, and other lighter work. The unit was built on a cost-plus basis for the Kansas City Southern, and other railroads have been watching the development of the invention with interest. If performance during trial runs on the K. C. S. comes up to expectations, unofficial commitments for about 100 of the units have been made by other roads.

The unit can be used anywhere along the line where shortages of ice occur, and it can be hooked onto any freight and pulled to the spot where it is needed. It will eliminate breaking a train so that refrigerator cars may be taken to ice stations. Trains can be serviced where they stand by pulling the ice plant alongside the main line.

The unit is simpler in operation than the present system of shipping ice by rail to service trains at small stations. The mobile ice plant can be used in any isolated spot with only a tank car of water for supply. It is completely automatic, requiring only a water supply, and produces 1,000 lb. of ice every 21 min. or 25 tons of ice a day. The unit operates 24 hr. a day with three men, one for each eight-hour shift.

The capacity of the machine is in sharp contrast to the present conventional method of ice-making, requiring 25 hr. to form a 300-lb. block. It takes six men to ice a refrigerator car by hauling up the 300-lb. blocks, chipping them, and prying the ice into place. With this unit, the ice is delivered in small



Haas Mobile ice factory for servicing railway refrigerator cars produces 2-in. ice cylinders with hollow centers — Length can be varied from fine shavings to 6-in. chunks —Power is supplied by two Caterpillar Diesel engines

pieces to the ice compartments of the refrigerator cars by one man who operates the entire unit.

The new ice is also said to be colder, contrary to the belief of many that all ice is the same temperature. The temperature of ice from the machine is 5 deg. F., while that of blocks made from brine tanks registers 26 deg. F.

The shape of the ice from the new machine is also an innovation. From the freezing unit it comes in two-inch cylinders with hollow centers. Its length can be varied from fine shavings up to 6 in. For bunker icing and top icing (the method used for fruits, leafy vegetables, and cream) cylinders 4 in. long will be used.

The K. C. S. Southern Belle colors, red, black and yellow will decorate the mobile ice unit when it takes to the road.

A tall cylinder which has the appearance of a silo contains tubes for the circulating ammonia. It is here that the freezing takes place, along with another action. After the ice is frozen and warm ammonia is directed into the tubes, defrosting takes place in the ice tubes. The formed ice cylinders slide down into a rotary blade that slices them off onto a screw-type conveyor. The slicing blade is similar to a circular lawn mower reel and operates in much the same manner. It can be adjusted to deliver the ice onto the conveyor in any lengths up to 6 in. or to shave ice from the cylinders.

The ice is carried by the first conveyor to the other end of the car where it is dumped into a storage room. From there a second bucket-type conveyor lifts it up to the top of the car at a height convenient for filling the refrigerator car. For traveling, the bucket conveyor which operates on a track may be pulled into the car.

Flexible couplings of the type developed by the navy for wartime use in engine rooms were used to solve the biggest problem in the design, that of vibration. Danger of pipes loosening at the threads was materially lessened by use of the flexible couplings.

One improvement already considered for incorporation in the next portable ice plant is the use of two freezing units which will eliminate the storage room and also double the capacity of the mobile ice plant.

Straightening Bent-Up Top Angles

Gondola and hopper car top angles are straightened in place at the E. J. & E., Joliet, Ill., car shops with the aid of a lever arrangement made by the shop forces. The arrangement consists merely of a large offset shape of heavy steel plate bolted to the car side, a section of scrap rail 6 to 8 ft. long, and several small pieces of plate to support the fulcrum end of the rail.

The first step in shoving down top angles which have been bent up is to apply the offset plate to the car side. This is done by burning three holes in the car side to line up with three holes in the plate, which is then bolted securely in place to the car side. One end of the rail is slipped through an opening in the top of the plate far enough to rest on the portion of the angle to be straightened, and the other end of the rail is attached to the crane by a chain. A few pieces of scrap steel plate are placed between the top angle and the bottom of the rail so that the rail will be approximately level when raised to apply a slight strain. The bent section of the top angle is heated with a torch and the free end of the rail raised. This causes the rail to act as a lever, applying a downward force at the opposite end of the rail with the fulcrum at the point of contact between the top of the rail and the top of the opening in the offset plate thus forcing the bent-up top angle back into proper shape.

The top-angle straightening arrangement in place for forcing a bent-up angle back into proper shape

The offset plate is $1\frac{3}{4}$ in. thick, 13 in. wide across the top and 10 in. across the bottom. The total height is 42 in. It is offset about 1 in. along a horizontal line 10 in. below the top. The opening through which the rail is inserted is 6 in. by 5 in. and the top of the opening is located 3 in. below the top of the plate.

Conveyor for Transporting Car Wheels

Both time and the risk of personal injuries are reduced by a gravity conveyor used at the Baltimore & Ohio shops in Cincinnati, Ohio. The conveyor serves both as a means of carrying the wheels to be bored into the shop and as a source of supply of wheels for the boring machine. As one wheel is

Raising a car wheel onto the conveyor for transporting to the boring machine

The entrance of the conveyor into the shop

lifted from the conveyor to the borer, another wheel automatically takes its place.

The wheels are carried one at a time on a Needham wheel carrier from the wheel storage area to the end of the conveyor adjacent to the storage area. The wheels are deposited on a pneumatically operated lifting apron which lifts the wheel onto the conveyor. From this place they travel into the shop and to the boring machine by gravity.

The conveyor is 65 ft. long and slopes from a height of 36 in. at the wheel storage end to 20 in. at the machine end. It has an inside width of 41 in., permitting it to handle wheels up to the size of 40-in. Diesel locomotive wheels. The total capacity of wheels which may be placed on the conveyor at one time is 24 33-in. wheels, or 20 40-in. wheels.

The conveyor is made up of a series of rollers 3½ in. in diameter mounted between 6-in. channels. It rests on 10-in. channels and has uprights of 3-in. channels. The apron at the wheel storage end is operated by a 10-in. air cylinder with a 28-in. stroke. This is operated by a straight air valve controlling air supplied by the shop air line through a feed valve at 30 lb. per sq. in. A cover of light gauge steel is currently being applied over the conveyor to protect the wheels from the weather.

Suggestions for Eliminating Hot Boxes*

The problem [of hot boxes] is one of the oldest. It has been with us throughout the history of railroading. The efforts put upon its solution should long ago have produced a satisfactory answer, yet no such results can be claimed. Our efforts, unfortunately, have been sporatic and often un-coordinated. The results show it—we still have far too many journal heatings, train delays and disasterous wrecks because of our dilatory and unthorough approach to the subject.

I have hopes that the revived interest in this subject is foretelling a satisfactory answer to the problem in the not too distant future, and a tremendous improvement in the very near future.

I am confident that Gustaf Metzman, president, New York Central, struck the re-kindling spark when he addressed the A. A. R. Mechanical Division annual meeting last June. He then, in no uncertain terms, charged us with the responsibility of arriving at the solution of the problem without delay. There is evidence that railroad and railroad supply men have accepted the challenge.

With the statement that the roller bearing, properly lubricated, is, in my opinion, the ultimate solution to the hot box problem in passenger service, and the railroads should go to that goal as quickly as possible regardless of cost, I shall pass on to the freight car lubrication and hot box problem.

In this field, the tremendous number of cars involved and the interchange problem, would appear to demand an equally satisfactory solution without the prohibitive expense which roller bearings would entail. I am confident that this can be done. Perhaps our experience with one group of box cars may point the way.

Pacemaker box cars, New York Central series 174000-174999, were built in 1945. They are 40 ft. 6 in. long, 10 ft. high, 9 ft. 2 in. wide, all steel box cars with standard A. A. R. underframe. The greater portion of these cars have A-3 ride control or Barber stabilized trucks. Twenty-five of them were equipped with Symington-Gould trucks.

The rated capacity of these cars is 100,000 lb., but one bolster spring has been removed from each spring nest and the capacity reduced to 50,000 lb. The average load carried by these cars in merchandise service is approximately 25,000 lb. Their light weight is 45,000 lb.

All cars are equipped with steel wheels, 5½ in. by 10 in. journals, and with friction bearings. The boxes are equipped with tight lids, deflector strips and packing retainer springs.

A total of 724 of these cars have been in Pacemaker service for the full period of time since built; 193 have been added to the service from time to time since and there were in this service as of August 31, 1949 a total of 917 such cars.

The records kept by the superintendent of car

* Abstract of a paper presented by F. K. Mitchell, manager equipment, New York Central at the Pacific Railway Club, November 10, 1949.

service indicate the average miles per car per month made by those cars in Pacemaker service is 3,482. The total Pacemaker mileage on this basis up to the end of August, 1949, was approximately 115,000,000. The records indicate that in that time there have been nine journal heatings recorded, none of which occurred since October 5, 1948. From that date to the present time over 42,000,000 car miles have been run without a journal heating.

The factors which no doubt affect the performance of these cars favorably are as follows:

(1) The bearing load is light. Based on 50,000 lb. reduced capacity, the journal load on a projected bearing area is 199.2 lb. per sq. in. Based on a normal average load of 25,000 lb., the journal load on a projected bearing area is 135.1 lb. per sq. in.; (2) These cars are assigned to service wholly within the New York Central Lines and are not used in interchange, therefore, they probably get closer attention than the average car receives; (3) Their service so far has been such that, with but few exceptions, the journal diameter is still very close to the original 5½ in.; (4) The fact that all are equipped with steel wheels; (5) The fact that the type of truck used provides a maximum lateral and vertical shock reduction; (6) The packing retainers; (7) The type of box lids; (8) The deflector strips; (9) The cars are seldom in such service as to be handled over humps and (10) They are protected with draft gears with rubber pads.

It will be noted that these Pacemaker cars have produced a hot box record of approximately 42,000,000 car miles. This figure is comparable with that which can be expected from roller bearings even in passenger service and probably exceeds what could be expected from that type of bearing in general interchange freight service.

To accomplish comparable results on all interchange freight cars and still use the solid type of bearing the following recommendations are submitted.

Recommendations for Immediate Action

1. Install in every interchange freight car a packing retainer which will hold the packing in place under impact regardless of any movement of the wedge, bearing brass or other parts contained within the box.
2. Reduce the impact level by an active campaign over the entire country for smoother train handling, careful switching and better control of car speeds in yard and hump switching.

(Here the Santa Fe journal box impact pictures will be of infinite help if widely distributed and wisely used.)

3. Every road should insist on better journal box servicing, better care of oil and packing to be sure of dirt and foreign matters being kept out of boxes.
4. Get our journal box lids and dust guards tight and use an acceptable method of keeping water and dirt out of journal boxes.
5. Give equally good attention to box roof and wedge contours. Too often the box roof or crown contour is overlooked, new wedges being applied to boxes badly worn in the roof area.
6. Get bad wheels out of service as rapidly as possible.

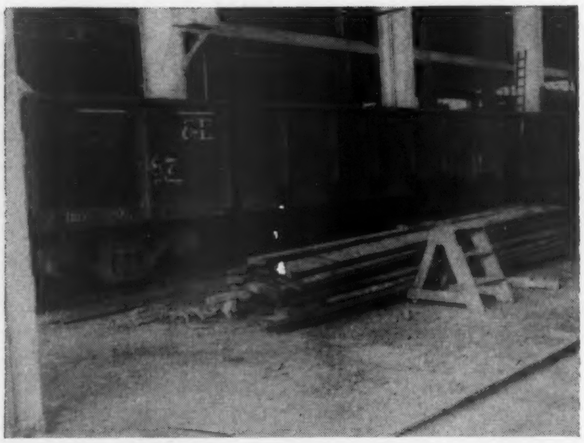
Recommendations for Long Range Action

1. Design our journals and bearings to reduce the unit bearing pressures as far as practicable. This may mean using a 6-in. by 11-in. journal where we now use a 5½- by 10-in. Pacemaker car experience certainly indicates a necessity for steps in this direction.
2. Redesign our axles and trucks to eliminate the collar and makes possible the restoration of journals to their nominal diameter. Stop using 5½-in. brass on journals turned down to 5⅛ in. and thereby running journal unit pressures up to dangerous limits. Quit scrapping axles because the journals are worn down to condemning limits. Without the axle collar any journal can easily and economically have a sleeve applied to restore the nominal journal diameter.
3. Design the underframe and draft gears to minimize impacts transmitted to journal boxes.
4. Program the renewal of the older trucks with those we know will not only give better lading protection but likewise afford better protection of journal bearings and box roofs.
5. Design our truck sides and box roofs to better enable them to withstand vertical impact without roof distortion.
6. Intensify our research on lubricating oils and waste so that we may use the minimum quantity of the best, instead of, as now is the case, using the maximum quantity of something which will pass.
7. Act now, don't wait for the other fellow to lead the way.

Composite Cars Get Pre-built Sides

The E. J. & E. recently completed a program of rebuilding 940 gondola cars that were built during the war and which had wooden sides from bolster to

The composite gondolas after stripping and ready for the application of pre-assembled riveted steel sides



Completed gondola car with all-steel sides

bolster. The cars, as rebuilt, are all-steel riveted construction with the exception of the wooden floor. During rebuilding the cars were stripped to the frame and new steel sides, floor nailing stringers and, where needed, new floors were applied. The steel drop ends were straightened in a hydraulic press, and all truck and other necessary repair work performed.

Steel side sheets ¼ in. thick were assembled separately and applied as a unit. All the rivets were driven prior to assembly with the exception of those which connect the new side to the short steel section on each existing end and to the side sill connection. The holes in the side sill were punched after the new side was put in place because of the bulging and distortion which all cars naturally receive from service. Any sag existing in the car was removed in place as far as possible.

Straightening Warped Floor Boards

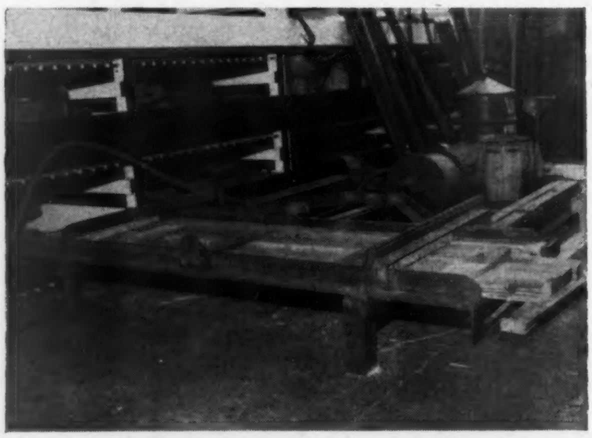
Car shop personnel on the Wabash at Decatur, Ill., have constructed a device that permits the use of badly warped floor boards for repair work by straightening them for application in pre-assembled groups of two to four tongue-and-groove boards. The straightener consists of a scrap 12-in. air cylinder, an arrangement for transmitting and applying evenly force to the group of boards, and a means for forcing and holding them flat for the straightening operation.

The warped boards are laid in a frame 9 ft. long and 40 in. wide made from angle iron 3 in. by 3 in. They are forced flat by driving wedges between the boards and two bars across the top of the frame. If further force is required, there is a pair of jaws welded at the center of the long dimension of the frame into which a third bar can be slipped and wedges driven between it and the boards.

With the group of boards (one to four as needed for the floor repair) held flat, the air piston straightens out the warp in the major cross-section dimension. Then, with the boards held flush against each other with the tongues and grooves mating, the boards are secured as a group by common nailing to small temporary boards which are nailed to all the boards in the group. After the group of boards has been applied and is in place as a part of the car floor, the small nailing boards are removed.

The air cylinder is held by six bolts to two angles 4 in. by 4 in. by ½ in., and these angles in turn are welded to a base made of the same-size angle. The force-transmitting linkage is made from three angles 3 in. by 3 in. by ⅜ in. The two side angles are set with one flange vertical while the center member is set like the letter V. This center member is strengthened by a 1-in. plate welded across the top opening of the V. The cross bar which contacts the edge of the nearest board is a box section made by welding an angle 3 in. by 3 in. by ⅜ in. to a second angle, 4 in. by 4 in. by ½ in.

The frame in which the boards rest is made from six angles 3 in. by 3 in. by ⅜ in. and one angle 4 in. by 4 in. by ½ in., which forms the long-dimension side away from the air cylinder. Two of the 3-in.



Box car floor boards warped in any or all dimensions are straightened for application in pre-assembled groups of two to four

Inserting a typically warped board into the straightener

angles are on the ends. The other four are located in two pairs welded together with a 1-in. filler plate to form a T-section, the top of which is level with the top of the horizontal flange of the other end angles to give the boards a flat resting surface. The T-section made from welding the two angles together and the filler plate is 16½ in. from each end. At the center of the long dimension, one jaw made of 1-in. plate is welded to the center of the 4-in. angle and a second to the center of the box section which contacts the end board and which applies the force of the air cylinder.

Two 20-in. long springs are fastened to each side of the straightener to return the force applying mechanism to the starting point when the air is released from the cylinder. The end farthest from the air cylinder is hooked to an eye welded on the force-transmitting linkage while the second end is hooked to the fixed portion of the straightener.

Maintenance of Vapor Steam Heating Equipment*

Q.—How often should the No. 955 regulator be overhauled?

A.—At least once every two years.

Q.—Should the No. 960 regulator have 7/32 in. clearance?

A.—When the regulator is cold, the clearance should be 7/32 in. to ¼ in.

Q.—Why are the floor heat valves de-energized when open?

A.—The floor heat valve is normally open unless the solenoid closes it to prevent freezing by having heat on the car whether anyone is in it or not. The overhead solenoid is normally closed because it is not necessary to prevent that part of the car from freezing.

Q.—Our valves waterlog in 35- or 40-deg. temperature.

A.—On the No. 955 regulator, the valve as first built had the same spring as the No. 900 regulator. During mild weather the regulators are not active enough because of the time it takes the bellows to contract. We have now concentrated on the No. 955QQ which is the old No. 900Q with stronger spring.

Q.—Sometimes they don't work at all. We have them set at 50 lb. but still they won't pop. Why?

A.—In the newer regulators, and we are trying to cover it in the overhaul periods, the No. 955CC valve assembly (the safe control valve) was originally built with a huddle ring around the valve assembly. After the valve had been in service sometimes particles of dirt or foreign matter lodged under this huddle ring and would prevent the No. 955CC from closing tight. This would allow a blow of steam over the diaphragm bellows No. 900E every time the regulator started to feed steam into the loop, causing the bellows to expand immediately—shutting off the main valve and starving the system of steam.

New regulators have a small test cock applied to the loop side of the regulator. If the car is not heating properly with steam on, opening this test valve or cock determines where the trouble is. If you get a blow of steam from this valve the regulator is feeding steam properly to the loop and the trouble must be inside the car; if no steam blows from this valve after it is opened 45 seconds or longer the trouble is in the regulator.

Q.—Should the reducing valve be set for 50 lb.?

A.—Fifty pounds is standard setting of the 955 pressure-reducing arrangement.

Q.—What might be done to correct overheating of roomettes, which is one of the more common complaints?

A.—All of our steam heat admission valves are of one standard size, because when we build a valve we don't know whether it will be used on 6 ft. or 60 ft. of radiation. Therefore the valve has been designed so that it will pass a maximum of steam to heat one entire side of car. Tests have been run to help overcome this condition.

First, in the riser steam pipe to the admission valve we have put in the union fitting an orifice of selected size for the radiation it feeds. This limits the amount of steam that can be fed to the smaller rooms. *Second,* use of 953CC valve has become standard. This valve consists of a 3-lb. spring on the safe-control feature; that means that no more than 3 lb. of pressure is entering the loop, which is enough steam supply to feed short radiation on multiple room cars. Three pounds are used on room cars only, while eight pounds are used on open coaches, diners, etc.

Q.—In some cars where there are two rooms, such as a lounge and a cafe section or tavern it is more advantageous to use a split evaporator, each section being fed separately. The unit is placed in the center of the car and the ceiling is so low that it has been advisable to use an overhead heat valve of the No. 1658 type at the floor line. Can you describe that briefly?

A.—The No. 1658 valve is designed to be placed in a riser pipe anywhere between the regulator underneath the car and the overhead. Arrangement in the No. 1658 valve is slightly different from the No. 1668 in that the latter has an attraction type magnet, whereas the No. 1658 has a plunger-type core so that in maintenance of that valve it is always well to take the solenoid off and clean out the core that the armature works in because that is subjected to steam and it might form corrosion and rust or some other feature that would prevent its operation. In cleaning and overhauling this equipment, one of the most detrimental solutions is gasoline. Gasoline evaporates very quickly and has a tendency to leave a deposit on the equipment that is hard to get off and can't be blown off. We recommend kerosene for cleaning the equipment.

* These questions and answers were submitted following a talk at the November meeting of the Northwest Carmen's Association by James E. Morris of Vapor Heating Corporation.

SHOPS AND TERMINALS

Air Reservoir Removal Facilitated

A device used at the E. J. & E. Diesel enginehouse at Joliet, Ill., simplifies the normally difficult task of removing or applying air reservoirs from those Diesel locomotives on which the reservoirs are mounted transversely underneath the frame. The device consist of a four-wheel truck which can travel either forward or sideways, and a pair of portable tracks which span the top of the enginehouse pit and by which the truck is positioned. A jack on the top of the truck raises the drum for application and receives it when it is being removed. Four rollers are incorporated in the truck to support the drum for transporting and for hammer testing.

The first step in the removal of a transversely located reservoir is to span the width of the track pit with two 8-in. channels. Each of these is burned off along with each end of the web a distance of 1¾ in. so that the top of the web will set flush with the top of the pit rails when the channels are in place. The truck is then rolled across the channel until one pair of wheels rests on one side of the pit track and the second pair on the other side. At this point all four wheels are turned 90 deg. about a vertical axis, and the truck is moved parallel to the track with the wheels riding on the concrete floor. When the truck is underneath the reservoir, the jacking pad is raised to contact the bottom of the reservoir. While the drum is held in this position, the holding bolts are loosened and removed, and the drum lowered onto the truck, on which it is supported by four rollers. The truck is then returned until the wheels are opposite the two channels and drawn clear from the locomotive over the channels. The truck, with the drums in place on the four rollers, is removed to any desired location for performing the hammer test.

The truck is mounted on four 3-in. by 8-in. steel wheels. These are attached to the frame in such a way that they can be turned in a manner similar to furniture casters. On one end of the truck are two plates channeled out to hold the wheels in line depending upon the direction in which it is to be moved. On the other end are two plates for holding the wheels in line for transverse movement of the truck.

The main frame of the truck is a 12-in. channel dished along the center and to which is welded built-up sections of ⅜-in. plates that support the swivel wheel frames. Near the center of the main cross channel, a scissors-type automobile jack is welded. On the top of the jack lifting shaft a jacking pad made from a 15-in.-long section of a 12-in. channel is welded and supports the reservoir during raising and lowering. The four rollers which support the drum during the hammer test are mounted on ⅜-in. plates welded near each end of the main cross channel.

The wheels on the left are in position for moving the dolly across the channels while those on the right are aligned for movement up or down along the pit

Sanding Car for Diesel Locomotives

The need for constructing a separate sand drying facility at the Ivorydale Diesel fueling station of the Baltimore & Ohio at Cincinnati, Ohio, has been eliminated by constructing a standing car, such as shown in the illustration. The car consists of a steel tank holding 10 tons of sand and mounted on a four-wheel truck. It is moved by any available locomotive between the Diesel fueling facilities and an existing sand drying and loading facility at a coal dock about one-quarter mile away.

The tank is made of ⅜-in. steel sheet, and is 60 in. in diameter, 8 ft. high and cone shaped at the top and bottom. There are two outlets on the bottom which connect to 1½-in. sand hose, 9 ft. long. These hose in turn connect to the top of a small sand storage tank at the fueling facilities. The sand is transferred from the car to this point by compressed air supplied through a ¾-in. air line which contains a reducing valve to cut the pressure entering the tank at the top to 35 lb. The tank is equipped with air gauges to check the pressure of the air used to


Car for transferring dry sand to a storage tank

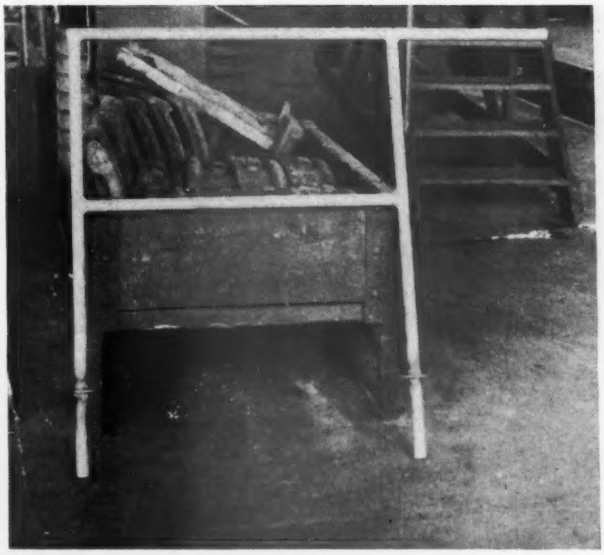
transfer the sand, and with a safety valve at the top set to pop at 40 lb. The average time required to transfer 10 tons of sand from the car to the storage bin is about 30 minutes.

Refilling the car with sand is done at the coal dock sand tank. The car is placed under this sand spout, and the sand flows by gravity through an 8-in. screw top.

Safety Hand Rail

A safety hand rail, shown in the illustration, is for application to Diesel locomotives, the hatches of which, when open to one side, leave a narrow walkway on the other side. With the hand rail in place, walking is as safe on one side as it is along the other. When any nut removal or tightening is required, the rail serves as a support for a man.

The two legs of the hand rail drop snugly into two 4-in. lengths of 1¼-in. pipe welded to the door uprights. Four of these are welded to the tops of uprights on each side of the locomotive and accommodate two safety rails placed end to end. The top member of each rail extends about 20 in. beyond one end to provide hand rail support for the sections where the top walking surface narrows to the width found along the hatches. The ends of the two safety rails used on each side of the locomotive are placed together so that these 20-in. extensions are outside.


Safety rail which fits into tubes welded to the door uprights on Diesel locomotives—Two of these are placed end to end with the top-rail extensions as shown at the right on the outer extremities

The rail is made of 1-in. pipe. It is of all welded construction and shaped as shown in the illustration. A 4-in. diameter washer welded 7 in. from the bottom of each vertical leg supports the railing when in place with the legs in the fixed 1¼-in. pipe supports. A segment of each washer on the side facing the locomotive is removed to allow the lower part of the safety rail to fit flush with the top parts of the door uprights.

Bearing Puller and Ram

A hydraulic bearing puller and ram for Diesel locomotive wheel bearings which is convenient to use, and fast in operation, has been developed in the Erie shop at Marion, Ohio.


The machine as used to remove a bearing

To apply a bearing, the tongs are swung inward to provide grips behind the wheel flanges

The axle, to which bearings are to be applied, or from which they are to be removed, is placed on a stand which holds the wheel flanges about 2 in. off the floor. The puller and ram is mounted on casters which make it easy to move into position. An oil cylinder supplied by a portable high-pressure reciprocating pump supplies the pressure required to apply or remove a bearing.

The supporting legs between the casters and the cylinder are adjustable so that the centers of the piston, or ram, and the axle can be made to coincide. Two arms, one on each side, pinned to the puller frame near the base of the cylinder, form a pair of tongs which, when swung inward, form grips behind the flanges of the wheel. There is a caster support on the end of each arm.

To apply a bearing, the tongs are swung in to grip the wheel, and the ram is used to apply pressure to the bearing through rings which fit the inner race.

To pull a bearing, a split, hinged ring is placed behind the back cover of the journal box. The split ring is drilled and tapped for eight threaded rods which extend from the ring to the holes in the rim of the circular plate at the rear end of the ram cylinder. The rods have welded-on heads and are set up equally with a wrench. The ram is then used to apply pressure on the end of the axle and to the rear of the journal box through the rods and the split ring.

A bearing can be pulled and another applied in 30 minutes.

A Skid for Handling Air Pumps

The illustration shows a skid developed by E. L. Lam, foreman of the air room at the Roanoke, Va., Shops of the Norfolk & Western for handling two cross-compound air compressors from the air room to the erecting shop. It is built of angles and steel plates and has eight U-shaped pockets, closed at the bottom, which hold the pumps on the skid. This places the pumps in the correct position for application to the locomotive and facilitates the application of jacket, air pump lubricators and pipe fittings.

This skid can also be used at enginehouses where

lift-deck-type tractors are in service or, if desired, the skid can be converted into a trailer by the addition of wheels.

Boiler Compound Storage Box

By W. E. Abbott

Boiler compound is received from the stores department in bags. It is difficult to remove the compound from the bags and also to find a place to leave the

unused portion so that it will remain dry and not be spilled.

The storage box illustrated will hold the contents of one bag. It is so mounted that it is not difficult to empty a bag into it and as it is covered, the contents remain dry.

The box is made from sheet iron. It is 12 in. sq. at the top, 3 in. sq. at the bottom, and 36 in. high. The square portion extends down 20 in. from the top at which point the taper begins. At the bottom end, angle iron is welded to the box forming slots through which a plate, with handle, slides to regulate the flow of compound into a bucket.

There is a piece of wire screen inside the box at the bottom of the square portion which keeps any large pieces from dropping to the bottom and lumps can be broken up on the screen.

The box corners are welded as are the brackets which are used to mount the box on a post.

Questions and Answers

The question and answer department is included for the benefit of those who may desire assistance on problems involving matters pertaining to the operation or maintenance of air brakes, Diesel-electric locomotives, steam locomotive boilers or steam locomotive practice. Any inquiry should bear the name and address of the writer, whose identity will not be disclosed unless special permission is given to do so. Anonymous communications will not be considered. Inquiries addressed to this publication will be referred to the source from which an authoritative answer can be secured.

Steam Locomotive Boilers

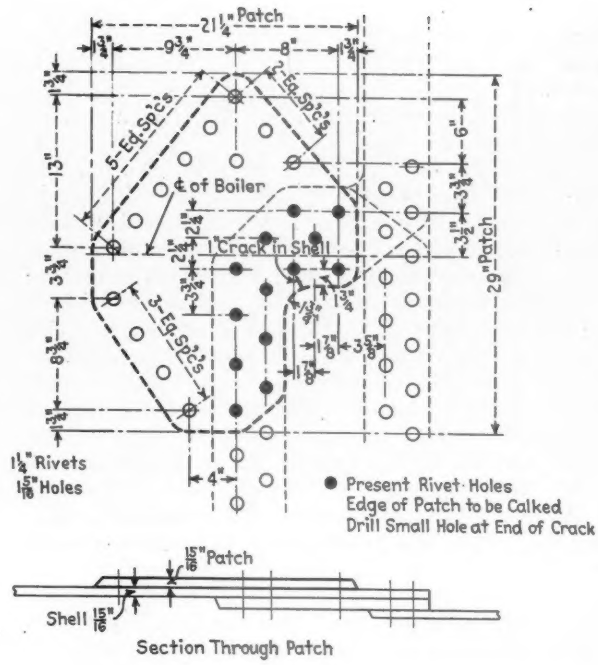
By George M. Davies

Welding Throat Sheet Cracks

Q.—Is it permissible to weld a crack in the outside throat sheet of a locomotive boiler?

A.—Welding is not permitted on any part of a locomotive boiler where the strain to which the structure is subjected is not carried by other construction which conforms to the requirements of the I. C. C. rules, including staybolts, crown stays, round, rectangular and gusset braces, arch or water bar tubes.

No welding is permitted on the outside throat sheet if closer at any point to the roll of the throat than one-half of the vertical distance from the top of the firebox ring to the roll of the throat measured through the same point on the patch or crack.



No welding is permitted in the radius of the vertical corner flanges. Cracks on flat surfaces not in the above restricted areas and not extending further than the distance between three staybolts may be welded.

Application of Arch Tubes

Q.—We are interested in the application of arch tubes to the firebox of locomotive boilers, method of preparing arch tubes and firebox sheets and manner of applying arch tubes to see where our practices differ from those in general use.—F. L. K.

A.—The general practice is to use three-inch outside diameter arch tubes for tube lengths of 11 ft. or under and $3\frac{1}{2}$-in. or 4-in. outside diameter tubes for length over 11 ft., with actual thickness of the tubes required computed by using the following formulae:

$$S = \frac{PD}{2E} + \frac{AB^2}{2W}\left(1 - \frac{}{2L}\right)^2$$

Where:

P = Steam pressure; lb. per sq. in.
D = Outside diameter of tubes; in.
E = Tube wall thickness; in.
A = Maximum weight of brick between two adjacent tubes, per 1 in. of arch length; lb.
B = Length of arch; in.
W = Section modulus of tube; in.
L = Length of arch tubes between supports; in.
S = Combined fiber stress due to steam pressure and arch tube loading; must not exceed 7,000 lb. per sq. in.

The tubes should be bent to a template conforming to the drawing dimensions and cut to the proper length. The length can be determined only by actual measurements of the firebox and allowance should be made so that the tubes will project from $\frac{3}{8}$ in. to $\frac{1}{2}$ in. into the water space at each end of the firebox.

When arch tubes are applied with the use of copper ferrules, the sharp edges of the tube holes

should be rounded off, the copper ferrules set in place and secured with a roller expander hand operated from the fire side of the sheet, the tube is then applied being fastened and flared with a roller flaring expander hand operated.

One of the later practices is to build up a boss around the tube hole, on the fireside of both the tube sheet and the firebox back sheet, with weld, making the diameter of the boss equal to the outside diameter of the tube plus 1½ in. and the depth so that the combined thickness of the boss and sheet is ¾ in. of the tube plus 1/32 in., the sharp edges being The tube hole is then drilled to the outside diameter removed by slightly rounding with a file or half-round burning reamer. The tube is then applied, without the use of copper ferrules, by securely fastening and flaring the tube in the hole with a seven roller flaring expander.

After the tubes are applied they should be thoroughly washed and swabbed out to insure that same are free from oil and other foreign matter.

Shearing Strength of Aluminum Rivets

Q.—How does the shearing strength of aluminum rivets compare with steel rivets? What advantages can be expected from the use of steel rivets in aluminum construction?—M.T.S.

A.—The shearing strength of aluminum rivets depends entirely upon the strength of the aluminum alloy from which it is made and upon the driving

AVERAGE ULTIMATE SHEAR STRENGTHS OF DRIVEN RIVETS

These values are for rivets driven with cone-point heads. Rivets driven with heads requiring more pressure may be expected to develop slightly higher strengths.

Rivet[1]	Driving Procedure	Shear Strength lb. per sq. in.
2S	Cold, as received	11,000
A17S-T3	Cold, as received	33,000
17S-T3	Cold, as received	39,000
17S-T31	Cold, immediately after quenching	34,000[2]
24S-T31	Cold, immediately after quenching	42,000[2]
53S-T61	Cold, as received	23,000
53S-T6	Cold, as received	26,000
61S-T6	Cold, as received	30,000
Steel	Cold, annealed	40,000
17S-T41	Hot, 930 deg. to 950 deg. F.	33,000[2]
53S-T41	Hot, 960 deg. to 1,050 deg. F.	18,000[2,3]
Steel	Hot, 1,700 deg. to 1,900 deg. F.	45,000

[1] Tempers shown apply to driven rivets.

[2] Immediately after driving, the shear strengths of these rivets are about 75 per cent of the value shown. On standing at ordinary temperatures they age harden to develop their full strength, this action being completed about four days for 17S-T31, 17S-T41 and 24S-T31 rivets, and in about two weeks for 53S-T41 rivets.

[3] This shear strength is for rivets driven at temperatures of 960 deg. to 980 deg. F. The shear strength increases about 1,000 lb. per sq. in. for each increase of 12 deg. F. in driving temperature. Thus, if the driving temperature range is carefully maintained at 1,030 deg. F. to 1,059 deg. F. an average shear strength of 24,000 lb. per sq. in. will be developed in the driven rivets.

procedure used. The Aluminum Company of America gives the shearing values for the various aluminum alloys as compared to steel which are shown in the accompanying table.

Steel rivets are stronger than aluminum alloy rivets and offer certain advantages in case of driving from standpoint of equipment required. However, their use is limited to those applications in which the structure can be protected adequately against corrosion.

Schedule 24RL Air Brakes

Emergency Position (Continued)

863-Q.—How does the seating of valve 199 affect the flow of air to the displacement reservoir and relay valve? A.—Seated valve *199* disconnects passage *3* and *3a*, therefore, the combined emergency reservoir and auxiliary reservoir air will flow through choke *181* to passage *3* and displacement reservoir and relay valve.

864-Q.—What governs the rate of build-up of air pressure? A.—The rate is determined by choke *181*.

Emergency With Rapid Build-up of Brake Cylinder Pressure (Short Trains)

865-Q.—What is the set-up to obtain the rapid build-up of brake cylinder pressure? A.—Rotair valve in Pass position, connecting pipe *35* to exhaust.

866-Q.—Describe the action further. A.—Chamber *B* is connected to the atmosphere which will permit piston *187* to move down and seat check valve *185*. When an emergency application is made, emergency reservoir air cannot flow past the seated check valve to chamber *D* on the left of the diaphragm and valve.

867-Q.—How does this affect the flow of air to the displacement reservoir? A.—When the combined pressure in passage *3a* reaches chamber *C* on the right of valve *199*, the diaphragm and valve are held to the left by spring *209*, flow is unrestricted from *3a* to *3* to the displacement reservoir and relay valve.

Accelerated Release After Emergency

868-Q.—When does this operation take place? A.—When brake pipe pressure is restored at a proper rate on the face of the emergency piston, after an emergency application.

869-Q.—What is the first movement after brake pipe pressure is restored on the face of the emergency piston? A.—The emergency piston moves to the right, compressing spring *65*.

870-Q.—What connections are made by emergency slide valve while the piston is in this position? A.—The emergency slide valve connects emergency reservoir pressure to the spring side of the high pressure valve through passage *2*, cavity *h* in the slide valve and passage *18*.

871-Q.—What results from these connections? A.—With air pressure thus balanced on the high pressure valve the spring moves the valve to its seat, cutting off supply of air from the emergency reservoir to the displacement and auxiliary reservoirs.

872-Q.—What happens when the emergency slide valve is in accelerated released position? A.—The displacement reservoir is connected to the under side of ball check *52a* and rubber seated check valve *53a*, through passages *3a*, *3h*, cavity *s* in the slide valve and passage *19*.

873-Q.—What action now takes place? A.—Since the displacement and auxiliary reservoirs are connected through port *n* in the graduating valve and cavity *D* in the service slide valve (which is still in application position), the pressure under check valves

52*a* and 53*a* is greater than brake pipe pressure above from passage *1*. Both check valves are unseated and the combined displacement and auxiliary reservoir pressures are permitted to flow through passage *1* to the brake pipe.

874-Q.—How long does this flow continue? A.—Until the pressures are within a few pounds of equalization.

875-Q.—Why is the development of brake pipe pressure needed to release the brakes accomplished sooner with this method? A.—Since the auxiliary reservoir pressure is partially reduced while the brake pipe pressure is being initially built up, the development of brake pipe pressure is accomplished sooner than it would be by raising brake pipe pressure through the brake valve alone.

876-Q.—When does the emergency piston return to normal charging position? A.—The quick action chamber is being charged through the charging choke. Return spring *65* will move the emergency piston and slide valve from accelerated release to normal charging position as soon as pressures on both sides of the emergency piston become substantially equal.

877-Q.—What action takes place in the service portion? A.—When brake pipe pressure becomes slightly in excess of auxiliary reservoir pressure, the service piston and slide valve will move to release position.

Diesel Locomotives*

Q.—What would cause carbon on valve stems and seats?

A.—Dirty intake filters will cause the engine to be starved for air resulting in the formation of carbon which will be deposited on the valves. Improper timing, excessive rack travel on the fuel pump or poorly adjusted valves will also result in the formation of the undesired carbon.

Q.—What causes valve seats and valves to pit?

A.—A plugged air filter will cause a vacuum to be created which will draw in dirt that will collect on the valves and seats and cause pitting.

Q.—What is the best setting of the fuel pump rack on 660- and 1,000-hp. locomotives in shut-down, idle and full throttle positions?

A.—Both the 660- and 1,000-hp. Diesel engines have rack settings of 7½ mm. and 10½ mm., respectively, for shut-down and idle settings. The setting at full throttle, however, is 24 mm. for the 660-hp. engine and 22½ mm. for the 1,000-hp. engine.

Q.—Can an out-of-time pump cause an engine to hunt?

A.—This depends on which way the pump is out of time. If the pump is timed late, there will be a loss of power but no hunting. If early, a heavy knock in the engine will occur which is the result of power surges. These power surges will make it appear as though the engine is hunting.

* These questions and answers were submitted following a talk at the August meeting of the Chicago Railroad Diesel Club by Chase Sherman, American Locomotive Company, on the fuel injection system of the Alco, 12½-in. by 13-in. engine.

Q.—What is the procedure in increasing or decreasing the engine speed on Alco 660- or 1,000-hp. switch engines?

A.—On the switching locomotive the throttle controls the governor through a mechanical linkage, the links of which can be lengthened or shortened by means of a turnbuckle to increase or decrease the engine speed as required.

Q.—What mechanical horsepower does an Alco 660- or 1,000-hp. locomotive develop at the generator?

A.—The 660-hp. Diesel engine delivers 625 hp. to the main generator and the remaining 35 hp. is delivered to the auxiliaries. The 1,000-hp. Diesel engine delivers 950 hp. to the main generator, the remaining 50 hp. being delivered to the auxiliaries.

Q.—What is the limit of wear on the pedestal frame shoes on a Diesel locomotive? What is the proper clearance? Is this covered by I.C.C. regulations?

A.—The allowable wear limits on the pedestal frame shoes are governed by I.C.C. regulations. On the switcher the new clearance is 1/32 in. on each side. The wear limit is ⅛ in. on each side or a total of ¼ in. on both sides. Because of the type of service encountered, a switcher used in road service should be maintained close to the new clearance limits.

Q.—How can you distinguish whether a weak locomotive is bad order electrically or mechanically? By checking fuel racks and speeds under full load? The only equipment I have is a tachometer.

A.—If at full load, the engine speed is correct and the racks are below the full rack travel, in all probability electrical maladjustment is the cause of the trouble. Again at full load, if the engine speed is down and the fuel racks are at full rack travel, in all probability mechanical difficulties exist although there is a possibility in this case too of the generator field resistances being improperly set causing electrical overloading.

Q.—What is the proper procedure for testing a Bosch fuel pump on a test stand to insure another term of service?

A.—The proper testing of a fuel pump requires a test stand which is equipped to measure the delivery pressure, the amount of fuel delivered and the proper timing. Usually the ordinary test stand found in the railroad shop is not equipped for this exacting work.

Q.—Are the fuel pipes between the fuel pump and nozzle interchangeable between the 660- and 1,000-hp. switching locomotives?

A.—There is a stamping of .107 or .135 on the fuel pipe nut which indicates respectively whether the pipe in question is applicable to the 660- or 1,000-hp. locomotive, and indicates the internal diameter of this pipe.

Q.—If you have a smoky exhaust, how do you distinguish whether the nozzle or the fuel pump is at fault?

A.—There is no sure method of determining the cause. It is considered the best practice to change the nozzle first and if this doesn't correct the smoking the pump should be changed. This procedure is followed because of the fact that if the pump is faulty, the nozzle will, in all probability, be covered with carbon because of the poor combustion and excessive heat, and will require changing in either case.

NEW DEVICES

King Wheel-Slide Indicator and Control

The King wheel-slide indicator and control, recently developed by the Spring Packing Corporation, Chicago, is designed to prevent serious accidents and casualties caused by the power wheels on Diesel and electric locomotives sliding as a result of armature-shaft bearings freezing, pinion gears shearing, or any other condition which might cause the power wheels to slide. This device applies the train brakes when from any cause power wheels slip above a predetermined speed. It differs from other wheel-slide indicators and controls which reduce brake-cylinder pressure when wheels begin to slip or slide in brake applications.

The King equipment consists of (1) mechanically actuated control switch (*normally closed*), included in a housing fastened to the cover plate of the combination journal-bearing box and driven from the end of the axle by means of an A. A. R. spline fitting and spline-drive shaft; (2) a master switch, the same as described above but *normally open*, which may be driven from either a power wheel or an idler wheel; (3) an indicator box which warns of wheel sliding and indicates the pair of wheels involved and the truck in which they are located; (4) a time delay and relay switch; (5) an air-operated solenoid valve; and (6) and air-brake applicator valve.

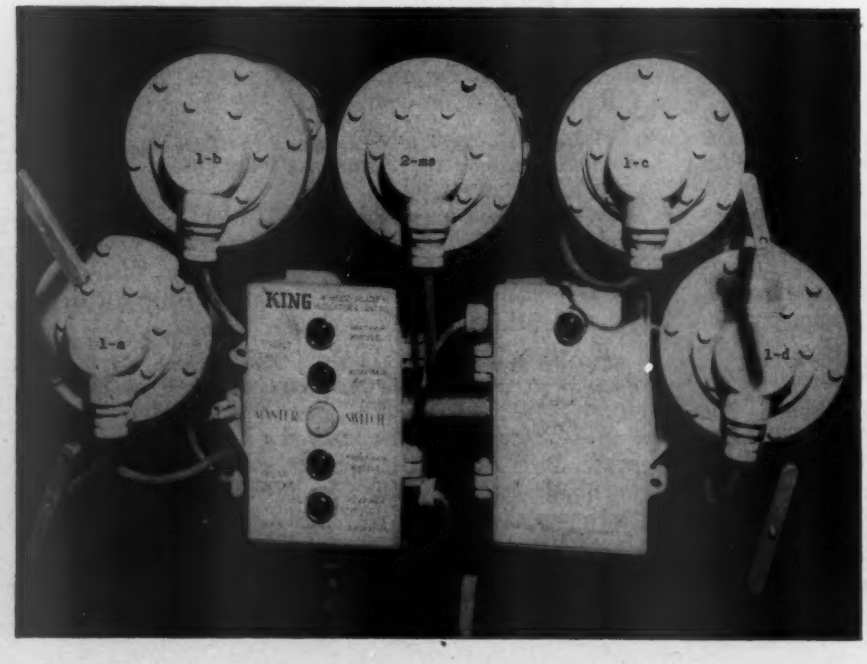
Parts 1 and 2 are located on the trucks of all locomotive units. Parts 3, 4, 5 and 6 are located inside the cab on *A* or head-end units only. The device operates independent of all other locomotive equipment except to apply the air brakes. Electrical energy is obtained directly from the storage battery, or in case of electric locomotives from a transformer. If a locomotive consists of more than one unit, then the circuits are made continuous by the use of jumpers between adjoining units, similar to those now used with electro-pneumatic brakes.

In operation, after the speed of the locomotive reaches a set point, the master switch is closed and electric energy is then available at the control switch on each pair of powered wheels. If all wheels are turning, then the control switches are *open* and this will be indicated by a green light only, on the indicator panel. Should a pair of powered wheels start sliding from any cause, at or above the set speed, then in addition to the green light on the indicator panel a red light will show, indicating which pair of wheels is sliding and in which truck they are located. At the same time, an alarm will be sounded.

If the speed of the locomotive is not reduced below a set speed within a suitable time, the time delay and relay switch (4), being energized, will cause the air-operated solenoid valve (5) to function. When this valve is energized, it operates the air-brake applicator valve (6), which in turn automatically applies the locomotive and train brakes and will continue to apply them until the speed has been reduced below the predetermined speed adjustment of the master switch. The brakes may then be released, and the defective unit set out, or at least the main track cleared as long as the speed does not exceed the limiting speed adjustment of the master switch.

The brake applicator valve is a simple differential valve, applied in the main-reservoir supply line, between the main reservoir and the automatic brake valve, and in the brake pipe. In normal or operating position, main reservoir pressure simply passes through the body of the valve, through the feed valve and automatic brake valve, and back through the brake pipe. Whenever the brake applicator valve is operated as the result of a wheel-slide indication, main-reservoir pressure is admitted to the outer side of the large differential piston, by action of the air-operated solenoid valve, thereby balancing the pressure on each side of the large differential piston. The small differential piston then moves the differential valve in the opposite direction, causing the slide valve of the differential valve to close the communication between the main reservoir and the automatic brake valve, and opening a service application valve in the brake-pipe chamber of the brake applicator valve. This vents brake-pipe pressure to the atmosphere through the service exhaust port of the brake-pipe chamber of the brake applicator valve and causes a full service application of the pneumatic brake.

Control switches on power wheels are shown at 1-a, 1-b, 1-c, 1-d.—The master switch 2ms is on either a powered wheel or an idler wheel—These go on all locomotive units — Signal boxes and control mechanisms go on A units only



Cleaning Material Simplifies Maintenance

A new agent, designed for keeping walls and working surfaces of water-washed paint-spray booths clean and free of overspray, has been announced by Oakite Products, Inc., 146 Thames st., New York 6. This material, known as Composition No. 45, is said to permit longer

operation of paint spray booths between regularly scheduled maintenance cleaning.

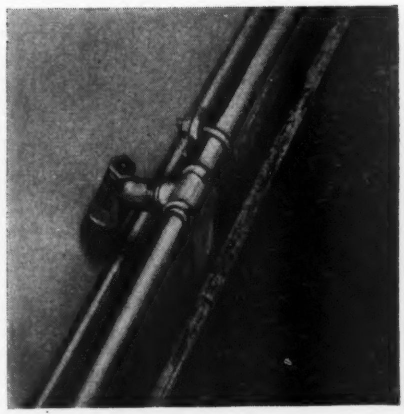
The composition, as reported by the manufacturer, prevents the adherence of overspray to aprons, baffles, lines and flood sheets of water-washed paint-spray booths. It possesses the ability to float many of the organic coatings commonly employed. Other coatings are emulsified, and still others sludge out or settle to the bottom of the solution tank.

This material may also be used for stripping organic finishes which coat paint racks, hooks and similar spray booth equipment.

Permanent Fire-Control For Diesel Locomotives

A permanently installed system of carbon-dioxide fire protection has been developed for Diesel-electric locomotives by the American-LaFrance Foamite Corporation, Elmira, N. Y. The first installation was made on a 2,000-hp. American Locomotive passenger unit on the Lehigh Valley. The system includes both fire detection and fire extinguishing functions. The fire extinguishing system is actuated by a push button in the cab of the leading unit when the functioning of the detection system causes an indicator lamp to be lighted. Clearly marked push-button stations, accessible from the ground, are also placed under each side of each unit of the locomotive.

The fire-extinguishing system consists of a battery of five 50-lb. carbon-dioxide cylinders connected by manifold to the distributing pipes which are laid along the sides of the engine cab near the floor with branches leading into the high-voltage and low-voltage cabinets. These branches terminate in special baffle nozzles. Twelve



Above: The distributing pipe and one of the outlet nozzles at one side of the main compartment—Right: A fire detector in the engine room

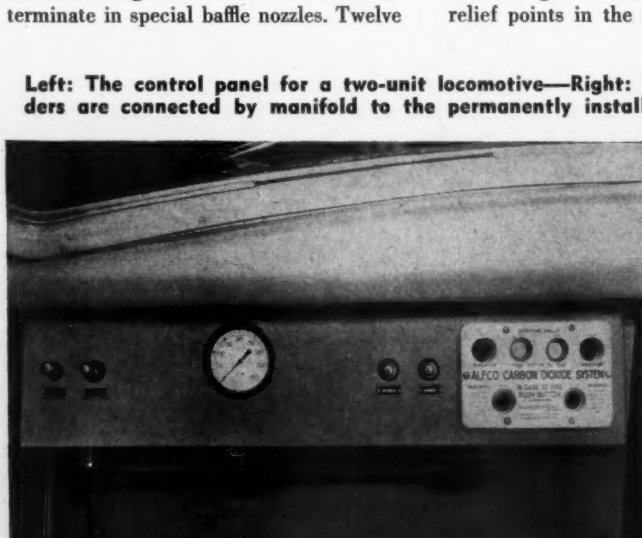
more of the discharge nozzles, connected in the distribution pipes, cover the main compartment.

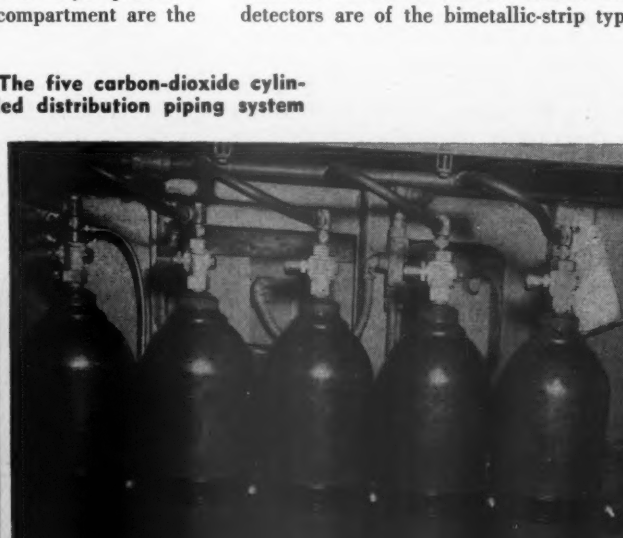
Tests have shown that adequate carbon-dioxide concentration cannot be obtained in the main compartment when the Diesel engine is running. Therefore, a pressure-operated switch, which is normally closed, is located in the carbon dioxide piping near the low-voltage cabinet. The gas pressure opens this switch, which is in the governor clutch coil circuit, and kills the engine while the extinguisher system is operating.

Carbon-dioxide gas is about one and one-half times as heavy as air. One 50-lb. cylinder contains 430 cu. ft. of gas at atmospheric pressure, and the operation of the extinguisher would build up a pressure in the unit higher than atmosphere if there were no outlet for air or gas from the compartment. With the Diesel engine dead, the major pressure-relief points in the compartment are the air filters. These are several feet above the floor and air is vented through them while the carbon dioxide is concentrated in the lower part of the compartment with relatively little dilution and waste through the vents.

Each locomotive unit is provided with six fire detectors, four in the main engine compartment and one each in the high-voltage and low-voltage control cabinets. The detectors over the engine and generator are far enough off the longitudinal center line so that they do not interfere with the removal of the roof hatch. The detectors are of the bimetallic-strip type

Left: The control panel for a two-unit locomotive—Right: The five carbon-dioxide cylinders are connected by manifold to the permanently installed distribution piping system





and are calibrated to close the detector circuit at 215 deg. F. This circuit, when closed, lights an indicator lamp in the operator's cab and also sounds a siren which is inserted in the circuit. This is placed in the main compartment and serves as a warning to personnel to vacate the space before the crew operates the extinguishing system.

Each Diesel locomotive unit is provided with its own fire-extinguishing system, with no connecting piping between units. The control and detector circuits, however, are carried forward and terminate in a control panel in the operator's cab of the forward unit. Both circuits are actuated by 64-volt battery current. On the control panel are mounted detector lights, one for each unit of the locomotive, a test push button for each detector circuit, and a separate push-button control switch for actuating the extinguisher system of each locomotive unit.

Depression of the push-button control switch fires the electric squib type operating heads on two of the carbon-dioxide cylinders. The remaining cylinders are simultaneously discharged by the carbon-dioxide pressure from the first two cylinders. All of the carbon dioxide in the cylinders is discharged through the baffle type discharge nozzles into the main compartment and the two electric control cabinets.

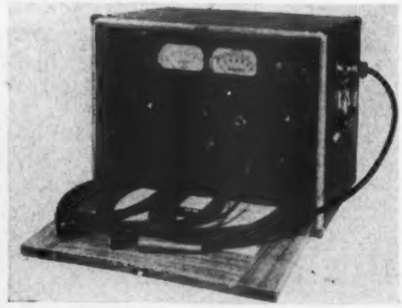
Each of the two outside remote-control stations consists of a push-button switch box on the cover of which are instructions for operating the switch in case of need. These permit operating the extinguisher system even if the locomotive is unoccupied, or if the fire occurs on a booster unit which has been separated from the A unit.

Insulating Tester

The Radio Frequency Laboratories, Inc., Boonton, N. J., announces a portable insulation tester that provides complete facilities for taking insulation resistance and dielectric absorption measurements on cables, transformers, rotating machinery, condensers, etc. Breakdown voltages also can be accurately determined with a minimum of damage due to burning.

The unit incorporates several improvements over earlier models as a result of extensive field tests conducted on nearly all types of power company, railway and communication equipment. Equipment successfully tested with the new Model includes a 50,000 kva. generator, a five-mile cable and a complete Diesel locomotive.

Resistances ranging from 0.1 to 50,000 megohms may be read directly on a megohmmeter scale at open circuit voltages of 0.5, 1, 5, and 10 kv. or may be simply calculated in ranges from 0.3 to 20,000 megohms from the readings of a



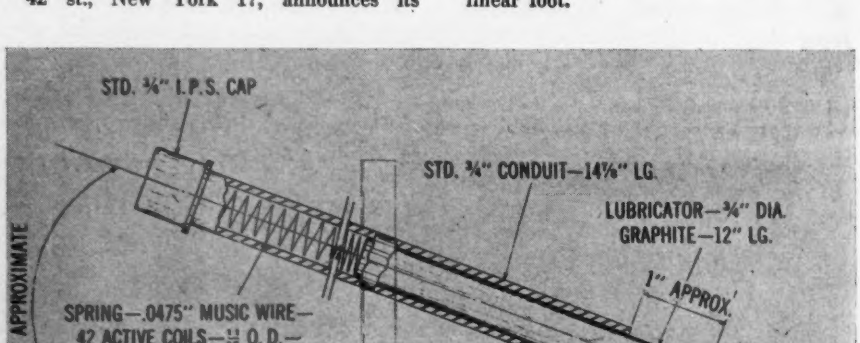
voltmeter and microammeter connected to read resistance at any desired test voltage operating from zero volts to 10 kv. The alternate methods are selected on one switch. Leakage current ranges are 30, 150, 300 and 1,500 microamperes, readable at any voltage. A shield terminal provides a guard circuit which by-passes the meter avoiding false readings. For polarization checks, a polarity reversing switch allows switching either the positive or negative side of the voltage supply to the high voltage terminal. The tester operates from a 115-volt, 60-cycle line and consumes a maximum of 65 watts.

Safety features include a relay for automatic and rapid removal of dangerous capacitance charges remaining on cables or condensers after test. A relay connects the output terminals through a 50,000-ohm, 100-watt resistor when the power is turned off. Provision is made for remote control of the line switch. The microammeter is protected against overload by a neon lamp that also indicates breakdown of the test specimen.

Graphite Wheel Flange Lubricating Rods

The National Carbon Co., Inc., 30 E. 42 st., New York 17, announces its AWE grade graphite wheel-flange lubricating rods for reducing the flange wear of Diesel-electric and steam locomotive drive wheels. Two sizes, ¾-in. dia. by 12-in. long, and 1-in. dia. by 12-in. long, have been developed. These rods can be used in several makes of rod holders now in service as well as in simple holders, of the general type illustrated, which can be readily fabricated in railroad shops.

These lubricating rods deposit an adhering film of graphite at the point of high friction and wear and at that point only. The grade of material has been selected to eliminate many of the problems of existing flange lubricating equipment. The lubricated area will become sticky and pick up sand or other abrasive material.



DETAIL OF LUBRICATOR

Precision Aligning Level

The level illustrated is an addition to the line of equipment manufactured by The Bullard Co., Bridgeport 2, Conn. Its vial

is made of optical glass, specially ground and is mounted on two brass studs.

The casting is thoroughly insulated from the palm of the hand by means of a handle made from non-conductive material. These devices are made in two sizes, 18-in. and 27-in., which covers practically all leveling requirements of all types of machines.

The bubble in the vial has a sensitiveness of 5 sec. per arc graduation. This is equivalent to showing per graduation on the vial a variation of 0.0003 in per linear foot.

Insulating Tape

A 20-ft. roll of Scotch brand electrical tape has been made available by the Minnesota Mining and Manufacturing Company, St. Paul, Minn.

The new, shorter roll, described as a "job-size" roll, is designed to be a con-

venient, economic one-day supply of tape for an electrician with a steady schedule of wiring assignments.

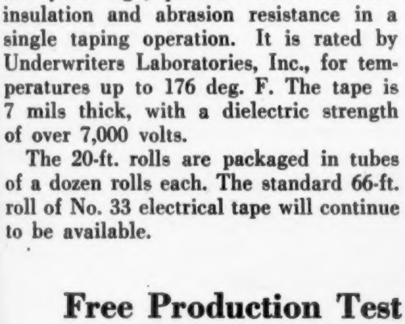
The plastic-backed tape, introduced two years ago, provides both electrical insulation and abrasion resistance in a single taping operation. It is rated by Underwriters Laboratories, Inc., for temperatures up to 176 deg. F. The tape is 7 mils thick, with a dielectric strength of over 7,000 volts.

The 20-ft. rolls are packaged in tubes of a dozen rolls each. The standard 66-ft. roll of No. 33 electrical tape will continue to be available.

Free Production Test Cleaning Service

Companies wishing to test a new cleaning method or material can eliminate the time, expense and bother of conducting cleaning tests on their own premises by taking advantage of a new free production test cleaning service. At the Magnus Chemical Co., Garwood, N. J., a wide variety of cleaning equipment and chemicals is available in a special building where full scale production cleaning tests can be conducted under actual working conditions.

The building is equipped with four



mechanically agitated cleaning machines featuring three different types of agitation. These are in addition to a turntable type spraying and rinsing machine. Two different types of cleaning tanks have also been installed, along with a drying oven, deburring and burnishing barrels, a steam gun and solvent cleaner sprayer.

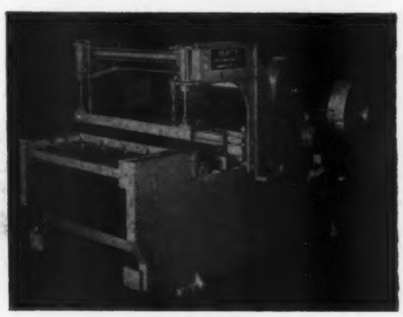
Both heated and unheated machines and tanks are available.

With this production equipment, it is possible to determine not only the best chemicals, equipment and method for achieving a desired cleaning result. In addition, actual cleaning times and costs can be accurately recorded as well. Thus, the best and most economical cleaning procedure can be determined in any particular case.

Magnus invites those companies interested in improving their cleaning set-ups to forward inquiries regarding the new service directly to them.

Air Activated Multiple Punch

A horizontal multiple punch has been announced and introduced by the Beatty Machine & Mfg. Co., Hammond, Ind. The machine shown is designed for mul-



tiple punching the flanges of long, wide sheets, and allows for punch tools to be mounted on varying centers across the ram face.

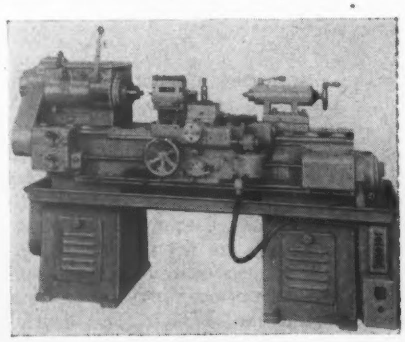
The unit is fitted with an air clamp device which holds the material down during the punching operation for gauging purposes. Stripping is accomplished by air cylinders which travel with the ram. Its frames are of welded steel plate. Clutches are of the jaw type with motor drive V-belt to flywheel.

The multiple punch is available in capacities from 50 to 300 tons. Following are specifications on the 200-ton machine, used as the illustration: distance between housings 63 in.; stroke 6 in.; stroke per minute 28 in.; die space, ram back 18¼ in.; ram width, vertically 10¾ in.; ram length, right to left, 72 in.; table width, vertically, 9 in.; table length, right to left, 72 in.; and depth of throat 5 in.

High-Speed Automatic Lathe

Simplicity of set-up for any given job is cited as an advantage provided by the Clipper, a high-speed lathe recently introduced by the R. K. LeBlond Machine Tool Co., Cincinnati 8, Ohio. For the average turning and facing job, there are no cams to make or change. The starting point is determined by the position of the micro-length limiting switch on the bed; length of cut being determined by a setting of the automatic length stop on the trip bar.

The machine runs automatically through a complete cycle; plunge to depth, turn, tool relief and rapid traverse to starting position. With the completely automatic apron, a cross feed mechanism



moves the tool in and out electrically. A positive, adjustable stop on the bridge of the carriage is set for desired depth of cut. Longitudinal feed towards the headstock is engaged by starting the machine. Tools feed to depth angularly and turning is then controlled by the regular feed mechanism.

The option of any three headstocks is offered. A regular anti-friction head, designed for medium spindle speeds, has two ranges of six selective speeds each: 68 to 400 r.p.m. or 102 to 600 r.p.m. A high-speed anti-friction head has two ranges, each with six selective speeds: 200 to 1,200 r.p.m. or 250 to 1,500 r.p.m. The high speed motor-head has the motor built into the headstock with the stator bolted to the casting and the rotor pressed into the spindle. It is furnished with one of nine spindle speed combinations varying from 450 to 3,600 r.p.m. Swing over the bed and carriage wings is 14⅞ in.

Adjustable Speeds for Small Motors

A fractional horsepower Mot-O-Trol electronic adjustable-speed drive is available from Westinghouse Electric Corporation. This control starts, stops, and controls the speeds of ⅛- to ½-hp. d.c. motors, operated from single-phase, 56/60-cycle, 220/440-volt power sources.

The drive uses armature control to make possible a speed range of 20 to 1 at constant torque. Smooth, stepless speed control is assured on either speed increase or decrease. The drive provides dynamic braking, overload and low-voltage protection. Separate field rheostats and line-starters are not required.

A small, compact control station is supplied for separate mounting at a location convenient to the operator. This control station is used to control starting, stopping, direction of rotation (on reversing design) and speed of the motor.

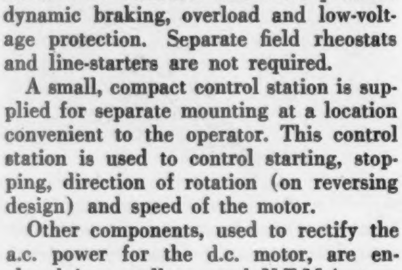
Other components, used to rectify the a.c. power for the d.c. motor, are enclosed in a wall-mounted N.E.M.A. type 1 enclosure.

Traveling Shaper

The illustration shows a new idea in tool design that has recently been developed by The Cincinnati Shaper Co., Cincinnati, Ohio. This unit can be used by manufacturers of parts requiring shaping over a large area of travel.

Employing the method of travel of a boring mill, the machine is capable of shaping a surface requiring up to 8 ft. of table travel without the need for resetting the work piece.

The shaper is built with a 36-in. ram



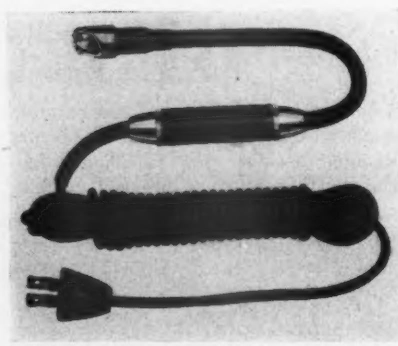
stroke, and has either hand or power feed and built-in power rapid traverse. It has two complete automatic oiling systems, one for the shaper ram feed and drive mechanism, and one for the saddle and ways on which the shaper rides.

Ram speeds are available from eight strokes to 102 strokes per min. The tool slide has a 9-in. vertical adjustment and power feed and the operator rides on a platform attached to the saddle.

The machine can be used for machining long, interrupted surfaces that do not lend themselves readily to planing.

Trouble Lamp

The Aero-Motive Manufacturing Company, Kalamazoo, Mich., announces a new addition to its line of Flex Lites, which is a combination Flex Lite and extension cord trouble lite. The new model which operates from a 110-volt cir-



cuit, comes equipped with a Flex extension approximately 12 in. long and a neoprene service cord 12 ft. long. The extension has a neoprene covering which will give long service and still retain the flexibility of battery models. The lamp is equipped with a guard approximately ⅝ in. in diameter.

Moisture-Proof Metal Primer Paint

The Thomson-Porcelite Paint Co., Philadelphia 6, Pa., has developed Led-Chroxide, a multi-purpose, moisture proof, metal primer that is more rust-proof than either red lead or zinc chromate when used by themselves. Their product is a balanced blend of red lead, zinc chromate, and iron oxide in combination with a specially developed vehicle that brings out the best characteristics of each of the rust-inhibiting pigments.

Led-Chroxide has a highly impermeable and rust-resistant film which provides a foundation for finish coats. It dries tack free in 2 to 3 hr., overnight for finish coats, and covers approximately 500 to 600 sq. ft. per gal., one coat, on smooth surfaces. It is said to have complete hiding power in one coat; will not check, peel, or crack and can be applied by either brush or spray.

Switching Locomotive Engine Recorder

An instrument incorporating a speedometer, a clock and odometer and which records the locomotive speed in miles per hr., the distance traveled, the time the locomotive is in motion and idle, has been introduced with a new "push-pull" development by the Valve Pilot Corp., 230 Park ave., New York 17.

This push-pull improvement of the cut-off mechanism has been designed for steam locomotives. Valve Pilots make a complete autographic record of speed and cut-off.

Speed recorders are used for indicating and recording speed and other operation features of steam, electric and Diesel locomotives. They are available in four types from 0 to 60 m.p.h., 10 to 90 m.p.h., 10 to 100 m.p.h., 10 to 120 m.p.h., and can be equipped with an automatic train signal forestalling recorder when used in train control territory.

The push-pull contributes to reduced maintenance. The equipment will function through tubing containing bends of 10-in. radius, provided not more than three such bends are required. This tubing can be applied under the jacket of the boiler or clamped to other piping along or underneath the running board.

Rolling Tube Expansion Control

A control which regulates automatically and accurately the amount of expansion obtained in rolling tubes in installations such as condensers and heat exchangers has been developed by Airetool Manufacturing Co., Springfield, Ohio.

It produces maximum tightness and holding strength in every tube joint and prevents distortion or breakage in the ligaments in the tube sheets. A precise control is established over the density or hardness of the metal in the tube wall and stresses resulting from rolling are reduced to a minimum.

The control, by accurately measuring the amount of current to the driving motor, provides regulation of motor torque and amount of expansion of the tube.

This system is built to withstand rough usage in shop or field work. It is designed without delicate tubes and is equipped with an automatic voltage regulator to insure uniform operation irregardless of normal voltage variation.

(NEW DEVICES CONTINUED PAGE 60)

NEWS

A.S.M.E. Railroad Division Installs New Officers

THE American Society of Mechanical Engineers Railroad Division, which held five technical sessions in conjunction with the annual meeting of the society at New York, November 29 to December 1, inclusive, tendered a formal certificate of appreciation before adjourning to retiring Chairman B. S. Cain, assistant engineer, Locomotive Division, General Electric Company, Erie, Pa., and installed the following officers for the ensuing year: Chairman K. A. Browne, research consultant, C. & O., Cleveland, Ohio. Executive committee members: E. D. Campbell (1951), retired; C. H. Beck (1952), vice-president, Westinghouse Air Brake Company, Wilmerding, Pa.; E. Pond (1953), assistant to superintendent of motive power, N. & W., Roanoke, Va.; G. W. Bohannon, chief mechanical officer, C. & N. W., Chicago. Secretary: E. L. Woodward, western editor, *Railway Mechanical Engineer*, Chicago.

E. H. Davidson, director, I.C.C., Bureau of Locomotive Inspection, was elected to the General Committee with term expiring in 1951, in place of Mr. Bohannon. Three new members elected to the General Committee, with terms expiring in 1954, included O. J. Horger, chief engineer, Railway Division, Timken Roller Bearing Company, Canton, Ohio; T. F. Perkinson, manager, Transportation Engineering Division, General Electric Company, Schenectady, N. Y.; C. K. Steins, mechanical engineer, Pennsylvania, Philadelphia, Pa.

Air-Conditioned Cars*

Figures showing the extent to which railway passenger-train cars were equipped for air-conditioning as of December 31, 1948, are now available. Of all passenger-train cars owned or leased by Class I steam railways, plus those of the Pullman Company, 34.3 per cent were so equipped. As indicated in the accompanying table, 87.3 per cent of the parlor and sleeping cars, 96.5 per cent of the dining cars, and 94.5 per cent of the club, lounge, and observation cars have air-conditioning equipment but for

* Data from I. C. C. Bureau of Transport Economics and Statistics Monthly Comment on Transportation Statistics, November 10, 1949.

SELECTED MOTIVE POWER AND CAR PERFORMANCE STATISTICS

FREIGHT SERVICE (DATA FROM I.C.C. M-211 AND M-240)

Item No.		Month of August 1949	Month of August 1948	Eight months ended with August 1949	Eight months ended with August 1948
3–	Road locomotive-miles (000) (M-211)				
3–05	Total, steam	30,935	45,125	266,300	356,078
3–06	Total, Diesel-electric	13,153	8,901	92,978	62,686
3–07	Total, electric	791	993	6,571	7,799
3–04	Total, locomotive miles	44,884	55,019	365,858	426,566
4	Car-miles (000,000) (M-211):				
4–03	Loaded, total	1,495	1,752	11,664	13,223
4–06	Empty, total	848	932	6,773	6,920
6	Gross ton-miles, cars, contents and cabooses (000,000) (M-211):				
6–01	Total in coal-burning steam locomotive trains	51,392	74,998	425,756	560,582
6–02	Total in oil-burning steam locomotive trains	13,428	21,331	116,768	165,108
6–03	Total in Diesel-electric locomotive trains	37,719	26,095	265,788	180,893
6–04	Total in electric locomotive trains	2,120	2,540	17,776	19,234
6–06	Total in all trains	104,682	124,972	826,154	925,872
10	Averages per train-mile (excluding light trains) (M-211):				
10–01	Locomotive-miles (principal and helper)	1.05	1.07	1.06	1.07
10–02	Loaded freight car-miles	37.40	36.50	36.00	35.50
10–03	Empty freight car-miles	21.20	19.40	20.90	18.60
10–04	Total freight car-miles (excluding caboose)	58.60	55.90	56.90	54.10
10–05	Gross ton-miles (excluding locomotive and tender) (000)	2,617	2,601	2,549	2,488
10–06	Net ton-miles (000)	1,178	1,241	1,154	1,173
12	Net ton-miles per loaded car-mile (M-211)	31.50	34.00	32.10	33.00
13	Car-mile ratios (M-211):				
13–03	Per cent loaded of total freight car-miles	63.80	65.30	63.30	65.60
14	Averages per train hour (M-211):				
14–01	Train miles per train-hour	16.70	16.10	16.80	16.00
14–02	Gross ton-miles per train-hour (excluding locomotive and tender) (000)	43,199	41,418	42,294	39,302
14	Car-miles per freight car day (M-240):				
14–01	Serviceable	41.80	46.80	42.00	45.40
14–02	All	39.10	44.70	39.70	43.40
15	Average net ton-miles per freight car-day (000) (M-240)	786	993	805	940
17	Per cent of home cars of total freight cars on the line (M-240)	50.70	37.50	50.50	38.00

PASSENGER SERVICE (DATA FROM I.C.C. M-213)

Item No.		Month of August 1949	Month of August 1948	Eight months ended with August 1949	Eight months ended with August 1948
3	Road motive-power-miles (000):				
3–05	Steam	15,006	19,541	127,157	154,942
3–06	Diesel-electric	13,258	11,086	97,381	81,306
3–07	Electric	1,634	1,820	13,379	14,356
3–04	Total	29,898	32,452	238,030	250,635
12	Total car-miles per train-mile	9.28	9.34	9.15	9.15

YARD SERVICE (DATA FROM I.C.C. M-215)

Item No.		Month of August 1949	Month of August 1948	Eight months ended with August 1949	Eight months ended with August 1948
1	Freight Yard switching locomotive hours (000):				
1–01	Steam, coal-burning	1,604	2,515	14,579	20,565
1–02	Steam, oil-burning	241	394	2,185	3,047
1–03	Diesel-electric[1]	2,104	1,701	15,435	12,721
106	Total	3,976	4,639	32,410	36,572
2	Passenger Yard switching hours (000):				
2–01	Steam, coal-burning	83	114	758	1,004
2–02	Steam, oil-burning	15	20	123	159
2–03	Diesel-electric[1]	216	193	1,635	1,461
2–06	Total	350	362	2,798	2,903
3	Hours per yard locomotive-day:				
3–01	Steam	7.50	10.20	8.40	10.50
3–02	Diesel-electric	17.40	18.40	17.50	18.40
3–05	Serviceable	13.40	14.00	13.40	14.10
3–06	All locomotives (serviceable, unserviceable and stored)	10.90	12.30	11.30	12.40
4	Yard- and train-switching locomotive-miles per 100 loaded freight car-miles	1.85	1.84	1.92	1.91
5	Yard- and train-switching locomotive-miles per 100 passenger train car-miles (with locomotives)	0.77	0.73	0.78	0.77

Note: [1] Excludes B and trailing A units.

PASSENGER-TRAIN CARS—CLASS I LINE-HAUL STEAM RAILWAYS AND PULLMAN COMPANY, AS OF DECEMBER 31, 1948

Class of cars	Owned and leased			Air-conditioned	
	Class I railways	Pullman Co.	Total	Total	Per cent
Coaches	17,071	....	17,071	6,512	38.1
Combination coaches	2,458	9*	2,467	649	26.3
Parlor and sleeping	1,491	5,296	6,787	5,923	87.3
Dining	1,730	....	1,730	1,670	96.5
Club, lounge and observation	385	....	385	364	94.5
Postal	1,724	....	1,724	....	....
Baggage, express and other non-passenger cars	14,028	....	14,028	87	.6
Other passenger cars	15	....	15	8	53.3
Other passenger-train cars	240	....	240	36	15.0
Total	39,142	5,305	44,447	15,249	34.3

* Represents composite cars.

coaches the percentage was only 38.1. The substantial progress that has been made in the air-conditioning of coaches, however, is indicated by the fact that only 29.7 per cent of these cars had such equipment in 1943.

Second Roy V. Wright Essay Contest

"To ENCOURAGE constructive thought on railroad problems by young people in railroad work and by students of transportation" the New York Railroad Club is again conducting the Roy V. Wright Prize Competition for the best essays on important transportation subjects.

Papers entered in the contest must be between 2,500 and 7,000 words in length; must be on one of 15 topics outlined by the club in its announcement of the contest, unless special permission is given to enter an essay on another subject; and must reach the club not later than February 28, 1950. There will be a first prize of $500 and 10 other prizes of $100 each in place of the first, second and third prizes awarded in the 1948-1949 contest. Names of judges will be announced later.

All inquiries regarding the contest should be addressed, and all papers sent, to the club's executive secretary, David W. Pye, at 30 Church street, New York 7.

Locomotive Size Gas Turbine Tested at Dunkirk

PRESIDENTS of nine leading coal-carrying railroads and five major coal-producing companies, at Dunkirk, N. Y., on December 7, saw an experimental gas turbine of locomotive capacity operating with pulverized coal as its fuel.

According to President R. B. White of the Baltimore & Ohio, and chairman of the Locomotive Development Committee of Bituminous Coal Research, Inc., the tests have shown that pulverized coal can be fed continuously to a combustion chamber and burned efficiently under a pressure of 60 lb. per sq. in.

"While it would be premature to assume that all of the technical problems are solved," Mr. White said, "the tests have shown that bituminous coal can operate a gas turbine. We are particularly pleased with the combustion efficiency, in excess of 90 per cent, and also with the performance of the ash removal equipment. Inspection of the experimental turbine following a 38-hr. run —equivalent to a round-trip by rail between New York and Chicago—showed that all components of the coal-burning gas turbine power plant were in excellent condition."

The coal-burning gas turbine has only three major components—the compressor, the combustor and the turbine. The gas which drives the turbine is superheated air. The gas turbine is simple, compact, requires minimum lubrication and attention, operates without smoke, and eliminates need for water.

Industrial leaders viewing the tests were luncheon guests of R. B. McColl, president of the American Locomotive Company, whose Dunkirk plant was used by the committee for installation of the full-scale stationary experimental gas turbine.

Laboratory work leading up to the tests has been carried on under the supervision of J. I. Yellott, director of research for the Locomotive Development Committee, by a number of organizations including Battelle Memorial Institute at Columbus, Johns Hopkins University at Baltimore, the Institute of Gas Technology in Chicago, and the Turbodyne Corporation at Hawthorne, Cal.

The turbine under test at Dunkirk was made available to the committee by the U. S. Bureau of Mines. The Allis-Chalmers Manufacturing Company, builders of the experimental turbine now in use at Dunkirk, has just completed the gas turbine which is destined to power the first coal-burning gas turbine locomotive. A second power unit, on order with the Elliott Company of Jeannette, Pa., is expected to be completed next spring.

New Painting Method Demonstrated

A COMPLETELY new method of painting metallic surfaces was demonstrated recently at New York by members of the Swedish firm of A. B. Antros, of Stockholm, which expects soon to be manufacturing the equipment in this country. This new process, called the Antropahl method, is a spraying job, with paint passing through an acetylene flame at the nozzle. This flame not only keeps the

An experimental locomotive gas-turbine installation at Dunkirk, N. Y.

Sustained

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paint at the proper temperature for application but preheats the surface to be painted so that a closer bond of paint and surface may be obtained. The paint itself, which is manufactured in Sweden by a secret process, contains no solvents and is transported in a solid waxy form. When painting is to be done, paint is placed in the tank, melted by electrical elements, and then forced through the hose and nozzle by air. No lead pre-coat is needed when Antropahl paint is used and it is said to prevent corrosion for a considerably longer period than ordinary paint.

The present spray gun can paint metallic surfaces at a rate of approximately 350 sq. ft. per hour.

The Odor Penetrates

During the past five years the New York Central has equipped the journal boxes of over 3,400 passenger-train cars and about 250 steam and Diesel locomotives with the Twinplex hot-box alarm, a description of which appeared on page 186 of the April, 1946, *Railway Mechanical Engineer*. Approximately one-quarter of the cars have roller bearings.

The alarms consist of two cartridges, from one of which a thick white smoke is discharged when a roller bearing reaches a temperature of 250 deg. F., or a plain bearing reaches a temperature of 350 deg. F. From the other, a penetrating and unpleasant odor is released at the same time.

Early in November road tests were run on two regular passenger trains to determine whether the odor released by a bearing approaching an overheated state is plainly noticeable in all cars of a passenger train except those ahead of the car in which the hot box occurs. For the purpose of the test a combination passenger-baggage car was provided with a detached 5½-in. by 10-in. journal box with a tightly fitting lid. This box was suspended under the car body near one of the trucks at approximately the same height and distance from the longitudinal center line of the car as the journal boxes on the trucks. A regular journal brass for use with the Twinplex alarm was mounted in the top part of the box. Heater coils were placed around the cartridge cavities in the brass and connected to the 32-volt car battery through switches in the passenger compartment of the car. The back of the box was closed and the bottom filled with asbestos cement to support the brass in its normal position.

Smoke cartridges were omitted during this test as it was undesirable to have the train stopped by a tower man or other roadside observer when the alarm was discharged. The test runs were between New York and Albany. On the westbound trip there were five coaches behind the test car. On the eastbound trip, there were 11 cars behind the test car, of which two were sleeping cars, one a diner, one a lounge, and one an observation-lounge. All were air conditioned.

Observers were stationed in all cars behind the test car and with the train running at 80 m.p.h. the switch on the bearing heating circuit was closed. The observers noted the time at which the odor from the alarm cartridge was first noticed within the cars. On both runs the odor was unmistakably present in all cars back of the test car. The times at which it was first noticed by the various observers from the first to the last car behind the test car were separated by a matter of a few seconds. The odor disappeared in about five minutes.

On the day of the tests the weather was fair and temperatures ranged between 50 and 70 deg. F.

ORDERS AND INQUIRIES FOR NEW EQUIPMENT PLACED SINCE THE CLOSING OF THE DECEMBER ISSUE

DIESEL-ELECTRIC LOCOMOTIVE ORDERS

Road	*No of locos.*	*Type of loco.*	*Builder*
Canadian National	8[1]	1,500-hp. road frt. units	Montreal Loco. Wks.
Canadian Pacific	40	1,500-hp. road units	Montreal Loco. Wks.
	4	1,500-hp. road units	Montreal Loco. Wks.
	3	1,000-hp. yard switch units	Gen. Motors Diesel, Ltd.
Green Bay & Western	4	1,500-hp. frt. units	American Loco Co.
Illinois Terminal[6]	9	1,000-hp.	American Loco. Co.
Missouri-Kansas-Texas	1[2]	1,600-hp. switch units	Fairbanks, Morse
	4[2]	2,250-hp. switch units	Electro-Motive
	9[3]	1,500-hp. switch units	Electro-Motive
	3[3]	600-hp. switch units	American Loco. Co.
Pennsylvania-Reading Seashore Lines	6	1,500-hp. frt. & pass. units	Baldwin Loco. Wks.
Texas & Pacific	7[3]	1,500-hp. switch units	Electro-Motive
Western Pacific	9[4]	4-unit, 6,000-hp. freight	Electro-Motive
	2[4]	2-unit, 4,500-hp. pass.	Electro-Motive

FREIGHT-CAR ORDERS

Road	*No. of cars*	*Type of car*	*Builder*
Nashville, Chattanooga & St. Louis	25[5]	70-ton covered hoppers	Pullman-Standard

[1] Delivery scheduled for January and February.
[2] Deliveries expected during first quarter of 1950.
[3] For delivery early this year.
[4] Delivery expected early this year.
[5] To cost approximately $155,000.
[6] In the December issue it was incorrectly stated that the Illinois Central had placed this order.

NOTES:

Canadian Pacific.—The Canadian Pacific on November 29 accepted delivery of one 2,250-hp. Diesel-electric passenger locomotive at the La Grange (Ill.) plant of the Electro-Motive Division of General Motors Corporation. This unit, along with two others ordered by the railroad to complete Dieselization of its Montreal-Boston passenger run, in conjunction with the Boston & Maine, was among the first seven of General Motors' newest E-8 design to roll off the assembly line at La Grange. Receipt of these three units will make the road's 171-mi. line between Montreal and Wells River, Vt., the second complete territory on the C. P. R. system entirely powered by Diesel equipment, the first having been the Esquimalt & Nanaimo Railway on Vancouver Island, B. C. According to N. R. Crump, vice-president of the road, the C. P. R., which has spent $30 million for new equipment since the close of the war, received its last steam locomotive about a year ago, and will probably buy no more. The C. P. R. will also receive from Electro-Motive one 4,500-hp. three-unit, F-7 Diesel locomotive for demonstration purposes.

Hudson & Manhattan.—The Hudson & Manhattan is contemplating expenditure of approximately $4,500,000, including about $1,107,510 for deferred maintenance, to modernize its properties. Among the proposed improvements are: New interiors and exteriors for all cars and new interiors for all stations, according to plans drawn by Henry Dreyfuss, industrial designer, and improved lighting facilities for cars and stations.

Southern Pacific.—The Southern Pacific has announced plans to purchase 3,100 new freight cars and give 900 box cars a general overhauling. Consideration is being given, the announcement said, to constructing "a substantial number of the new cars in the company's own shops, where the overhauling program will be carried out." Included in the new cars will be 3,000 steel box cars (of which 1,000 will be automobile cars, 500 to be fitted with the latest type auto-loading racks), and 100 65-ft. drop-end gondola cars.

Railroads Major Oil Consumers

Traditionally known as the nation's best all-around consumer, railroads are now one of the oil industry's better customers, because of their increasing use of Diesel locomotives, it was revealed recently.

The rise of railroads as buyers of petroleum products is traced in a study prepared by the research committee of the Eastern Railroad Presidents Conference, which shows that the railroads' purchases of petroleum products reached a record high of about $220,458,000 in 1948. The study, which said this figure would be exceeded in 1949, was based on figures for the first eight months of 1948 and projected through the year, the committee explained. While coal remains the biggest raw material purchase item of the roads, which burned 23 per cent of all bituminous and anthracite consumed in the nation last year, petroleum purchases now exceed the outlay for forest products, theretofore one of the principal items on the railroad supply account.

Only 13.8 per cent of all fuel consumed by the railroads on a dollar value in 1948 was Diesel, but Diesel engines hauled about one-fifth of all freight gross ton-miles, and more than one-third of the passenger train car-miles. Concerning the "growing community of interest between the railroads and the oil companies," the study points out that the Standard Oil Company of Indiana has predicted that by 1970 the railroads will require 9 per cent of the total production of the American oil industry.

SUPPLY TRADE NOTES

Cooper-Bessemer Corporation.—The Cooper-Bessemer Corporation, Mt. Vernon, Ohio, has opened a district office in Halifax, N. S. *J. A. MacLeod* is branch manager, directing all sales and service activities on Diesel locomotives and marine and stationary applications of Diesel engines.

◆

A. O. Smith Corporation.—The A. O. Smith Corporation has transferred the responsibilities and direction of sales activities for welding electrodes and equipment from the north central district, Chicago, to the welding electrode and equipment division, Milwaukee, Wis., under the direction of *J. T. Pritchard,* division manager. Mr. Pritchard has announced the appointment of *L. F. Vonier* as general sales manager of the division.

◆

Minneapolis-Honeywell Regulator Company.—*William W. Martenis,* formerly chief application engineer of the Minneapolis-Honeywell Regulator Company, has been appointed to the newly created position of manager of sales engineering. Mr. Martenis will assist in planning specifications, approve new developments and coordinate activity between the sales and engineering departments.

◆

American Arch Company.—Liquidation of the American Arch Company, a Delaware corporation, and the American Arch Company, New York, has been voted by the stockholders at a special meeting. Approximately 90 per cent of the 91,300 outstanding shares were voted in favor of the liquidation proposal. American Arch, in business for nearly 40 years, has supplied locomotive manufacturers, railroads and industrial concerns with arch brick and engineering and services. A company spokesman said that because of the rapid Dieselization of the railroads and the decline in purchases and use of steam locomotives, continued operation of the firm would not be profitable.

◆

Fairbanks, Morse & Co.—*J. A. Cuneo,* branch house manager for Fairbanks, Morse & Co. at Los Angeles, Calif., has been appointed manager of the company's branch house serving the Chicago area. He succeeds *John S. King,* transferred to Cincinnati, Ohio, as branch house manager, replacing *J. S. Peterson.* Mr. Peterson will be attached to the sales manager's office in Chicago, working on special assignments in connection with the company's scale division. *A. M. McLaren* has been appointed branch manager at Los Angeles, succeeding Mr. Cuneo. *William H. Kingsley,* district manager of the New York office, Ideal Electric & Manufacturing Company, has joined Fairbanks, Morse as manager of the Electrical Division, with headquarters in the company's executive offices in Chicago.

◆

Montreal Locomotive Works.—The following appointments have been made in the sales and servicing department of the Montreal Locomotive Works: *William J. Niles,* formerly assistant secretary-treasurer, has been appointed sales manager, and *I. I. Sylvester,* formerly transportation specialist of the Canadian General Electric Company, appointed technical sales engineer, Diesel division. *J. S. O. Neville,* who, for the past three of his 12 years with the company, has specialized in Diesel electrics, has been placed in charge of the Diesel-electric sales and service division.

Mr. Niles, since his association with the company in 1917, has been engaged,

William J. Niles

successively, in the supervision of plant operating expenses, estimating and production, as well as miscellaneous sales promotion. As assistant to the manager, he was specifically engaged in expediting the company's munitions and other wartime production during World War II. He was appointed assistant secretary-treasurer in 1946, in which position he continued until his appointment as sales manager.

◆

American Brake Shoe Company.—*William J. Grant,* formerly sales representative for the Brake Shoe & Castings and Southern Wheel divisions of the American Brake Shoe Company, has been appointed manager of Southern sales for the National Bearing division, with headquarters at Richmond, Va. *Harry C. Platt,* formerly works manager, has been appointed vice-president of the Engineered Castings division of the company, and *William H. Starbuck,* formerly assistant general sales manager, has been appointed vice-president of the Kellogg division.

◆

Johns-Manville Sales Corporation.—*John H. Trent,* vice-president in charge of transportation sales of the Johns-Manville Sales Corporation, has retired under the company retirement plan.

Mr. Trent entered railroad service in 1901 as an apprentice on the Illinois

John H. Trent

Central. He served in the mechanical and stores departments and later worked as storekeeper at Water Valley, Miss., Memphis, Tenn., and Paducah, Ky., until 1907, when he joined Johns-Manville. Since 1907 he has worked in various capacities, including general sales manager western region, general sales manager transportation and government department, and vice-president in charge of transportation sales.

◆

T-Z Railway Equipment Company.—The T-Z Railway Equipment Company and associated companies have appointed *Henry W. Stahl* as their exclusive railway sales representative in the New England area, with headquarters at 42 Broadway, New York.

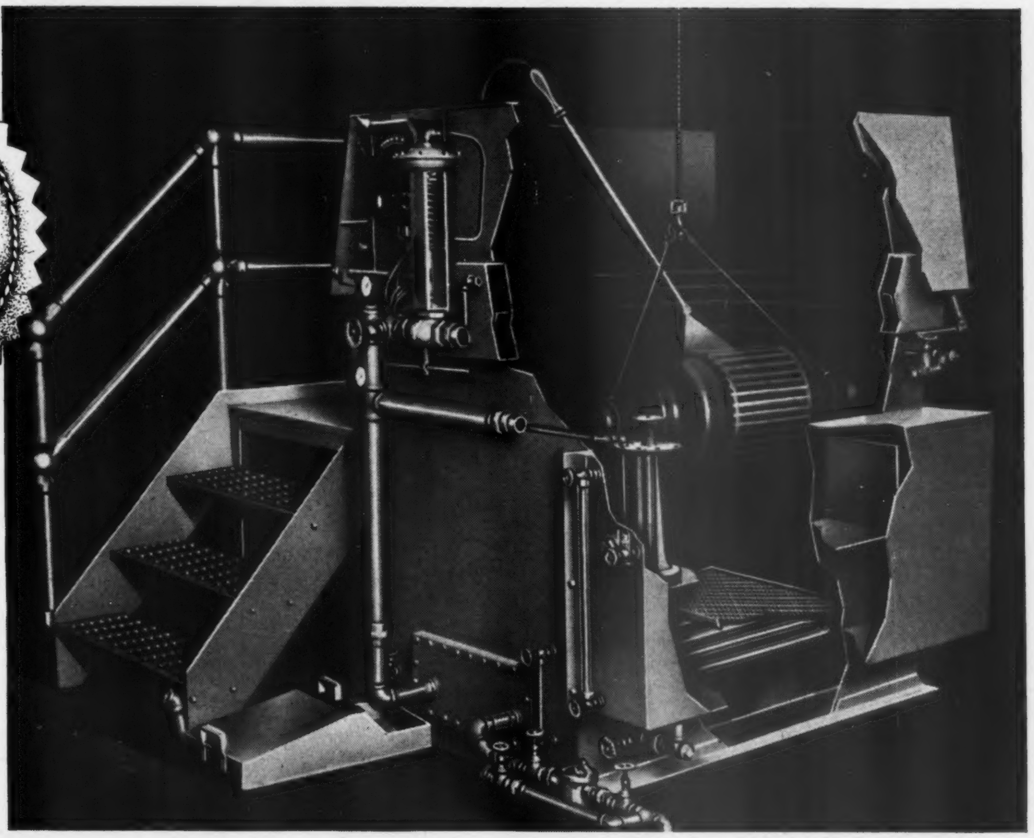
◆

SKF Industries.—A series of two-day courses in service inspection of anti-friction bearing installations in traction motors of Diesel-electric locomotives has been inaugurated by SKF Industries for railroad personnel who service such engines. Supervisory personnel of eastern

PROVED *and* APPROVED

by

RAILWAY SHOPS



DETREX VAPOR-SPRAY DEGREASER

Saves 7½ HOURS PER DAY

In Cleaning Diesel-Electric Parts

Armatures, frames and other parts of Diesel-electric traction motors are cleaned in *15 to 30 minutes* in the Detrex unit shown above. By ordinary methods, this job usually takes 8 hours—a saving of over 90% in cleaning time alone.

This unit quickly removes grease, oil and road dirt, with safety to all mechanical and electrical parts. The non-flammable solvent penetrates into slots and crevices—thoroughly cleans all surfaces, inside and out. On leaving the degreaser, the parts are *completely dry* and ready for further operations. Extra rinses and oven dry-off are eliminated.

And the Detrex Vapor-Spray Degreaser gives you a complete cleaning system in a single, compact tank—in *50%-75% less floor space* than you need for other cleaning methods.

GET FULL DETAILS on these and other benefits available through this equipment. All Detrex products are fully guaranteed and are backed by 30 years of high quality service in the parts-cleaning field.

DETREX DETROIT MICH

DETREX *Corporation*

BOX 501
DETROIT 32, MICHIGAN

railroads, including shop foremen and superintendents, locomotive inspectors and mechanics, were represented at the initial session on December 6 and 7 at SKF's main plant in Philadelphia, Pa. Representatives of railroads in other sections of the country will be invited to attend future sessions.

◆

STANDARD CAR TRUCK COMPANY.—The offices of the Standard Car Truck Company, Chicago, have been removed to Room 1250, 332 S. Michigan avenue.

◆

LUNKENHEIMER COMPANY.—*Paul M. Arnall* has been appointed vice-president and general manager of the Lunkenheimer Company. Mr. Arnall was formerly executive vice-president and director of the Ohio Injector Company.

◆

ORME COMPANY.—The Champion Brake division of the Orme Company of Chicago has appointed the *National Brake Company*, New York, as its exclusive sales representative for the sale of Champion-Micro-Matic brakes in the United States, Canada and Mexico. The Champion-Micro-Matic hand brake will be marketed as the Champion-Peacock-Micro-Matic brake.

◆

UNION CARBIDE & CARBON CORP.—*Douglas H. Pittman*, general supervisor in the maintenance of way department in the Southeast for the *Oxweld Railroad Service Company*, a unit of Union Carbide & Carbon Corp., has been appointed southeastern representative.

Obituary

B. A. CLEMENTS, retired vice-chairman and former president of the American Arch Company, New York, died on November 23. He was 72 years old. Mr. Clements was elected president of American Arch in 1927 and named vice-chairman in 1947. He retired a year later.

◆

JOHN L. HOFFMAN, southeastern representative for the Oxweld Railroad Service Company, a unit of Union Carbide & Carbon Corp., died recently, after 27 years of service with the company.

◆

FRANCIS JAMES HOOD, president of the Ansul Chemical Company, died on November 10, while on a business trip in New York. He was 44 years old.

PERSONAL MENTION

General

WHEELING & LAKE ERIE-NEW YORK, CHICAGO & ST. LOUIS.—Pursuant to authority of the Interstate Commerce Commission, the lines, properties and rights of the Wheeling & Lake Erie have been

STANDARD ENGINEER'S REPORT

RPM CALOL

TEST DATA

UNITS Westinghouse Locomotive Air Compressor 8½" Cross Compound

LUBRICANT Calol Air Pump Lubricant

TEST PERIOD 1 year

LUBRICATORS Westinghouse F-1-A

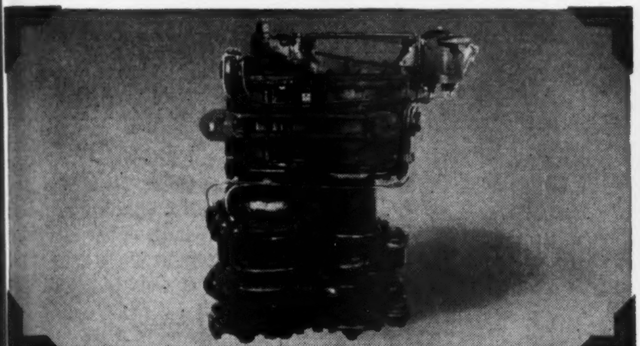
ENGINE M-137-151 — 2-8-8-2

CONDITION Main Line Operation - 1% grade

LOCATION Oroville, Calif. - Portola, Calif.

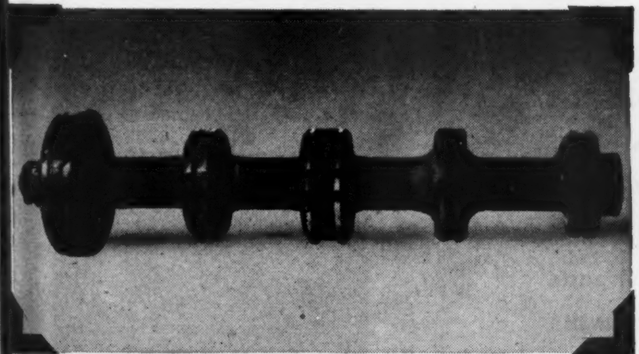
FIRM Western Pacific R.R. Co.

TEST SHOWS NEW OIL SUCCESSFULLY LUBRICATES BOTH STEAM AND AIR ENDS OF AIR COMPRESSOR

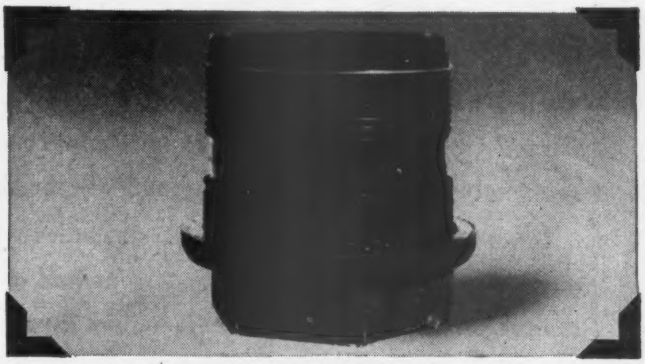


Calol Air Pump Lubricant was used for a full year in a compressor like this, on a locomotive in regular service. It was supplied to both ends by removing the plug between the lubricator's two reservoirs.

This Air Discharge Valve was in the compressor during the test. As the photograph shows, at the end of a year's operation, it was free of carbonaceous deposits. Calol Air Pump Lubricant resists oxidation.



No lacquer or gum appeared on the Steam Differential Valve and wear was negligible. Valve rings and steam piston rings stayed clean and unstuck. Calol Air Pump Lubricant resists highest temperatures.



The Air Discharge Valve Cage was clear of excessive oxidation deposits, as were air pistons and their lands and rings. The use of Calol Air Pump Lubricant eliminates the necessity for frequent cleanup jobs.

REMARKS: Another compressor of the same size and type was operated on the opposite side of the locomotive. During the test, it was lubricated with a conventional type of Grade A valve oil. This compressor's valves and valve cages became filled with an appreciable amount of carbon. Also, considerable deposits of carbon and lacquer accumulated in air discharge passages.

Calol Air Pump Lubricant eliminates these conditions because it is a doubly-compounded oil. It is highly stable both in use and in storage. Its special compounds help resist oxidation by air, heat and moisture. They keep pistons, rings, ring-land areas, air passages, valves and other parts clean, and maintain a tough lubricant film on hot and cool spots alike in the most severe operation.

STANDARD OF CALIFORNIA • San Francisco, Calif.
THE CALIFORNIA COMPANY • Denver, Colo.
STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA OIL COMPANY • Barber, New Jersey

leased by and unified with those of the New York, Chicago & St. Louis and will be known as the Wheeling & Lake Erie district of the Nickel Plate. The following changes have been made in the personnel of the electrical and mechanical departments: *E. A. Hamilton*, signal and electrical engineer of the W. & L. E., has been appointed superintendent of electrical equipment of the Nickel Plate system at Brewster, Ohio, and *J. W. Cameron*, engineer of tests of the W. & L. E., has been appointed to the same position on the Nickel Plate at Brewster. *J. O. Hill*, superintendent motive power and cars, and *R. J. Snyder*, assistant superintendent motive power and cars, of the W. & L. E., have been appointed district superintendent of motive power and assistant district superintendent of motive power, respectively, of the new W. & L. E. district of the Nickel Plate, with headquarters as before at Brewster. The jurisdiction of *R. Schey*, general superintendent car department, and *D. J. Coon*, mechanical engineer, of the Nickel Plate, have been extended to include the W. & L. E. district.

IRA G. POOL, general superintendent of motive power of the Great Northern at St. Paul, Minn., has been appointed general manager, Lines East of Williston, N. D., with headquarters at Duluth, Minn. Mr. Pool was born on November 11, 1891, at Minneapolis, Minn., where he attended the public schools. He took a course in mechanical engineering with the International Correspondence Schools. During the summer vacation of 1908 he entered railroad service as a helper in the car department of the Minneapolis, St. Paul & Sault Ste. Marie at Minneapolis. After holding various positions on the Soo Line, he was employed successively by the Utah Copper Company, Bingham, Utah; the Gray Tractor Company, Minneapolis; and the United States Steel

Ira G. Pool

Corporation, Eveleth, Minn. In 1920 he joined the G. N. as locomotive designer at St. Paul. He subsequently served as fuel supervisor at St. Paul and at Great Falls, Mont., until 1929 when he was appointed assistant master mechanic, serving successively at Havre, Mont., and at Whitefish, Mont., until 1932, when he became master mechanic at Klamath

Falls, Ore. In 1933 he was appointed enginehouse foreman at Bieber, Calif., later in 1933 returning to Klamath Falls as enginehouse foreman. In 1935 Mr. Pool became fuel supervisor at Spokane, Wash.; in 1936, master mechanic at Grand Forks, N. D.; in 1941, master mechanic at Spokane, and in 1942, general superintendent of motive power.

R. W. Harter, assistant superintendent of shops of the Chicago, Rock Island & Pacific, has been appointed acting superintendent of the Silvis (Ill.) shops.

Electrical

Paul Lebenbaum, whose retirement as electrical engineer, Southern Pacific Lines, at San Francisco, Calif., was reported in the December issue, was born in that city on October 20, 1879, and attended the University of California, Berkeley, Calif. Mr. Lebenbaum was employed by the General Electric Company prior to entering railroad service. In January, 1903, he joined the North Shore (now Northwestern Pacific), and the following November went with the S. P. as assistant electrical engineer at San Francisco. He was appointed electrical engineer of the Oregon-Washington Railroad & Navigation Co. (now Union Pacific) at Portland, Ore., in 1909. In 1911 he became electrical engineer on the Portland, Eugene & Eastern (now S. P.), in charge of electrification of steam lines radiating out of Portland. He subsequently became electrical engineer on the Portland division of the S. P., at Portland, and in 1921 was appointed assistant electrical engineer, S. P., Pacific Lines, at San Francisco. In 1932 Mr. Lebenbaum was appointed electrical engineer at San Francisco.

Master Mechanics And Road Foremen

J. E. Kerwin, superintendent of the Chicago, Rock Island & Pacific's Silvis (Ill.) shops, has been appointed master mechanic of the Missouri-Kansas division, with headquarters at Kansas City, Kan.

G. W. Nelson has been appointed assistant master mechanic of the New York Central at Buffalo, N. Y.

R. F. Batchman has been appointed assistant master mechanic of the New York Central at Syracuse, N. Y.

K. O. Thomas, master mechanic of the Missouri-Kansas division of the Chicago, Rock Island & Pacific at Kansas City, Kans., has been granted a leave of absence because of illness.

W. G. Ringland has been appointed master mechanic of the New York Central, at Albany, N. Y.

Obituary

Joseph F. Bodenberger, who retired on December 1, 1947, as general road foreman of engines of the Chicago, Milwaukee, St. Paul & Pacific, died on November 19.

Andok B IN THIS TEST

HAS RUN OVER 300,000 MILES!

DURING TEST no additional grease has been added! ...inspection shows bearings in journal box are in excellent condition!...Esso **ANDOK B** has maintained its remarkable lubrication qualities even after the 300,000-mile record was set..., and the road test is *still going on!*

FIELD TESTING like this on Esso Railroad Fuels and Lubricants is one of the practical follow-ups on the extensive research Esso constantly carries on in America's largest petroleum laboratories...making *doubly sure* you can *depend* on the railroad products that bear the Esso brand.

CALL IN our Esso Sales Engineer on *any* fuel or lubrication problem that we can help you solve.

The Sign of QUALITY

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The Symbol of SERVICE

RAILROAD PRODUCTS

SOLD IN: Maine, N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Penna., Del., Md., D. C., Va., W. Va., N. C., S. C., Tenn., Ark., La.

ESSO STANDARD OIL COMPANY—Boston, Mass.—New York, N. Y.—Elizabeth, N. J.—Philadelphia, Pa.—Baltimore, Md.—Richmond, Va.—Charleston, W. Va.—Charlotte, N. C.—Columbia, S. C.—Memphis, Tenn.—Little Rock, Ark.—New Orleans, La.

New Devices

(CONTINUED FROM PAGE 52)

More Efficient Car Heating

A new development in railroad passenger car heating, designed to produce more efficient heating of fast streamlined trains, was recently announced as a joint development of the Vapor Heating Corporation and the Pullman-Standard Car Manufacturing Company, Chicago. The new method, now being installed in several lots of cars built by Pullman-Standard for the New Haven, Atlantic Coast Line and other roads primarily takes steam pipes and connections from underneath the cars and puts them in a shallow insulated trench in either side of the floor construction.

One of the insulated side trenches in the car floor which carries steam pipes formerly located under the car body

It is relatively easy to heat a train which is standing still but substantially more steam is required with trains moving at high speed, because wind wiping over the exposed pipes under cars, regardless of insulation, causes loss of heat which is avoided by placing the pipes in trenches in the car floor. This, combined with heating the side panels of cars, is a big step forward in more efficient passenger car heating.

One of the engineering problems in this development was to design a steam-tight swing-joint that would compensate for the expansion of the pipe when heated. One end of the pipe is anchored fast to the body of the car so it was necessary to work out a method of having expansion take place in one direction, only.

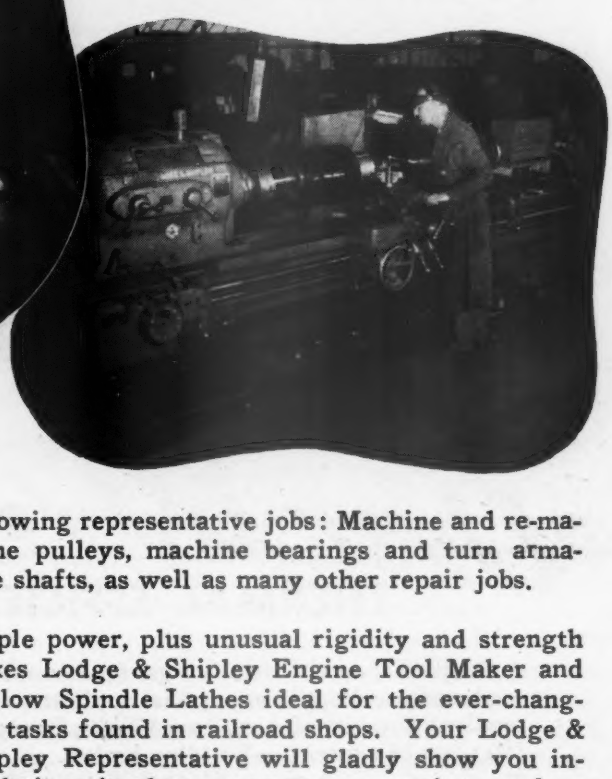
The illustration shows how a trench is built into the floor on one side of a car with the steam pipes placed in the trench and then insulated before the floor plate is put down. Also shown are the auto-

LODGE & SHIPLEY LATHES *"working on the railroad"...*

INSTALLED FOR LIMITED OPERATION... Now does *ALL* lathe work!

Turning 11" commutator down to 10⅝" for Gantry Crane motor armature on the versatile Lodge & Shipley heavy duty Model "X" Lathe.

IN ELECTRIC SHOP OF NOTED WESTERN ROAD



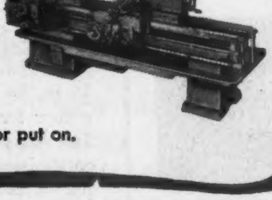
OUT in the "show-me" state of Missouri, a Lodge & Shipley Model X Lathe has done just that! Purchased to take care of occasional jobs, this lathe now handles all turning requirements in the electric shop at a large engine terminal which services both steam and diesel engines.

From a long list of operations performed are the following representative jobs: Machine and re-machine pulleys, machine bearings and turn armature shafts, as well as many other repair jobs.

Ample power, plus unusual rigidity and strength makes Lodge & Shipley Engine Tool Maker and Hollow Spindle Lathes ideal for the ever-changing tasks found in railroad shops. Your Lodge & Shipley Representative will gladly show you installations in shops near you . . . point out how Lodge & Shipley Lathes "working on *your* railroad" can reduce "out of service" time and cut maintenance costs. Write for free catalogs.

NOW **INSTANT CHANGEOVER FOR DUPLICATING OR REGULAR LATHE WORK**

The COPYMATIC is a dual-purpose machine . . . can be used for duplicating or regular lathe work without limiting the range of either. Takes but a minute to change the set-up . . . nothing to take off or put on.



THE **Lodge & Shipley** COMPANY

MACHINE TOOL DIVISION • 3055 COLERAIN
SPECIAL PRODUCTS DIVISION • 800 EVANS ST.
CINCINNATI 25, OHIO

matic steam valves which control the amount of steam allowed into the finned radiators along the floor of the car and the new swing-joint to compensate for pipe expansion.

Rotary Indexing Milling Table

The Chicago Tool and Engineering Co., 8383 S. Chicago ave., Chicago 17, has announced the development of a new model to its line of milling tables. It is the Model No. 86, which has an 8-in. diameter table with two 5/8 in. by 1 1/8 in. T slots crossing at the center.

This table is graduated for the full 360 degrees and the rotary table feed is positive through a worm and gear with a ratio of 40:1. Its indexing dial is graduated in 15 minute intervals and two hold-down clamps, with thumb screws are furnished for locking the table in position after indexing.

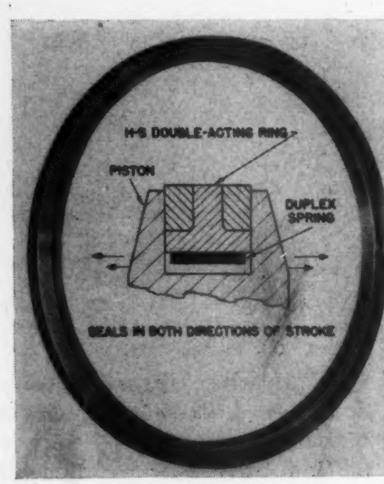
The unit is useful on jobs where a fixture takes up a large percentage of the distance between the spindle and machine table. With its two bolt and key slots, rigid mounting of the table to either a milling machine, drill press, shaper or surface grinder can be accomplished.

Three-Piece Piston Ring

The Hunt-Spiller Manufacturing Corp., Boston 27, Mass., announces a new three-piece gun iron piston ring for steam operated air pumps, pumps of various types, steam and air cylinders of stationary air compressors, and in air cylinders of electrically driven air compressors. One of the features of this ring is that the three-piece design eliminates blow-by in both directions of the stroke and thus acts as two rings when installed.

These rings, called Hunt-Spiller Double Acting Rings, are made in three pieces, a center section which is T-shaped and two flat sections which fit into the relieved sections of the T. Each of these pieces is cut into segments and the segments are dowelled in position so that the gaps between them cannot align. The number of segments depends upon the size of the ring.

The installation of these rings on new equipment is simplified because only one groove has to be machined around the piston head. When being installed as replacement equipment, the material between the grooves for single rings is machined out and the proper Double Acting Ring and Duplex Spring inserted. Double Acting Rings are made in sizes and widths for all replacement installations.



Light-Weight Shape Cutting Machine

The Air Reduction Sales Company, 60 East 42nd street, New York 17, has introduced a small lightweight oxy-acetylene shape-cutting machine that will cut any shape within an area 56 in. by 32 in., but which is light enough in weight that it can be conveniently carried to the work. It can be moved, complete with carrying case by two men, and, once unpacked, can be moved by one man. The machine weighs 110 lb. assembled, excluding the guide rail which weighs 35 lb. Packed in a wooden box 84 in. by 14 in. by 17 in. the machine and rail together have a shipping weight of 255 lb. The complete assembly carried in the box comprises a cutting torch and high-speed tip, a motor-driven manual tracing de-

vice, an 80-in. length of tubular rail, a 66-in. grooved straight-edge for making straight cuts, a radius rod for cutting circles, 25 ft. of extension cord, and 25 ft. of Airco-Twin hose.

Known as the Airco Monograph No. 3, the machine will cut any shape within an area 56 in. by 32 in. with a manually guided tracing device, circles up to 32 in. in diameter with a radius rod, straight lines 64 in. long when the straightedge attachment is placed diagonally across the cutting area, any desired length when equipped with tubular-rail extensions, bevel cuts at any angle up to 30 deg., and ferrous metals in thicknesses up to 8 in. The tracer wheel is motor-driven at any speed from 3 in. to 30 in. per min., and on shape cutting, is manually guided.

One of the features of the shape cutter is the practicability of its use at different locations which results both from its portability and its ease of setup. To prepare the Monograph for cutting, all that is necessary is to bolt the torch-bar roller housing to the carriage, put the machine on the tubular rail, hook up the hose, and plug in the tracer-motor extension cord.

The torch bar slides back and forth in its housing on eight adjustable ball-bearing housings, four on each end, to minimize friction and play. Movement of the torch in the lengthwise direction is on a ball-bearing four-wheel carriage that supports the torch bar housing and straddles the rail. All moving parts, such as the roller housing and carriage bearings, and the tracer-motor and tracer-shaft bearings, are lubricated for life, and the torch bar or the rail does not require lubrication. Surfaces of the torch bar are chromium plated, and those of the tubular rail are cadmium plated. The tracer wheel is counterweighted for sufficient tractive force even in the most extreme position.

Diesel Locomotive Sand Nozzle

A Diesel locomotive sand nozzle has recently been introduced by Fairbanks, Morse & Co., 600 S. Michigan ave., Chicago 5. It has had about a year's field test by various railroads before being generally shown to the industry. It is light in weight; constructed of steel tubing for long life; streamlined for ease of handling in any position without interference from projecting parts or handles; weather proof and leak proof.

Its mechanical construction results in ease of operation as the valve opens merely by pressing the ring against the sandbox opening, and it closes quickly by gravity when held in a downward position. This device is economical in the use of sand as little or no sand is wasted as it is when the valve is located at the top of the delivery pipes.

Three sizes are available with 2-, 2½-, and 3-in. diameters. Over all length is 12-in., and weight 7½-lb.